# Wild About Math

A collection of activities for the Casio graphing calculators 9750 and 9850 using authentic wildlife research data from the Virginia Department of Game and Inland Fisheries

Virginia Department of Game and Inland Fisheries

# Special thanks to


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# Table of Contents



At the end of each activity is a "Teacher Notes" section with answers to the questions.

# Introduction

At the turn of the twentieth century, Virginia's wildlife populations were low. Many species plentiful today such as the deer, beaver, and blue heron, had all but disappeared from the Commonwealth because of a lack of understanding about how wildlife populations respond to over hunting and because there were no laws safeguarding animal numbers. In 1916 the Virginia General Assembly established the Department of Game and Inland Fisheries to bring species like these back through legislation and effective wildlife management techniques.

The scientific field of wildlife management was new and experimental in the early 20th century. A variety of methods to restore wildlife populations were tried and many failed. Today, we know that habitat management, based on sound research, is the key to long term survival of any species. To be able to manage a habitat for the food, water, shelter and space needs of any given species, we need to know what the species' requirements are. Wildlife biologists at the Department of Game and Inland Fisheries design research projects that identify the habitat requirements as well as assess the health of the population. The statistics provided in this guide are the result of many years of data collection that has been based on a variety of research methods.

The Department also depends upon public support for the collection of additional data that otherwise would be difficult to obtain. Certain wildlife species can be hunted without adversely affecting their population. Citizens who hunt for deer and turkey are asked to provide age and sex of the animals they hunted. This provides a large sample size that could not be collected in other ways. Smaller samples of the population are taken through other methods including the mark and recapture technique, direct observations and actual counts.

For some species the Department uses the latest in technological methods. For example, the data on the swan activity was collected using satellite transmitters placed on just a few swans. Since swans fly in large flocks, only a few birds needed to be followed. What we found is that not all swans that winter in Virginia return to the same nesting grounds but instead scatter across the northern portion of Canada and Alaska. Similar transmitters have been placed on sea turtles, peregrine falcons and pintail ducks over the past 20 years. Radio transmitters followed by plane, boat or on foot have been also placed on bears, fish and even on the endangered canebrake rattlesnake.

Biologists Virginia Department of Game and Inland Fisheries are experts in their field; many have a Masters or Doctorate Degree in Wildlife Resource Management. If students would like additional information on careers in wildlife, visit: http://www.dgif.virginia.gov/jobs/careers-pamphlet.html#Wildlife.

# *A Weighty Issue*

Overview:
In this activity, students graph the growth of bear cubs that were part of a reproductive study done at Virginia Tech.

SOL Connections:
Math 8.12, 7.16, 7.18
Science 6.1, LS.1, LS.8

Background:
Black bears are found in all but a few eastern counties of Virginia, but the densest populations are in the western mountainous part of the state and in the south east corner, mainly the Great Dismal Swamp and surrounding areas. The population of bears is growing and spreading to practically all counties of the Commonwealth. The total number of bears in Virginia may be about 7,000 animals. Bears are nearly always solitary animals, with the exception of family groups (sow with cubs). The male and female have little or no contact other than during mating. Females spend a lot of effort feeding and fattening up before going into hibernation in order to produce healthy cubs. As part of a study conducted by the VA Department of Game and Inland Fisheries and VA Tech, small numbers of female black bears or sows were placed into captivity before hibernation. The sows were pregnant and gave birth to their cubs during the winter hibernation. The purpose of the study was to obtain growth data on cubs in order to be able to assess the health of cubs in the wild population. Similar data is being collected on sows and their cubs in the wild for comparison.

The cubs are born at about 224 grams or about the size of a guinea pig; they grow rapidly. At one year, cubs will grow from the 224 grams to about 22.50 to 31.50 kg. As part of the research project, every 10 days, the sows were immobilized and the cubs were weighed and other growth data recorded. Afterward, cubs were returned to their mothers who then woke up and continued to care for them. Once spring arrived and food was again plentiful, the sow and her cubs were released back into the wild.

More information on black bears and Virginia's Bear Management Plan can be found at http://www.dgif.virginia.gov/wildlife/bear/ .

Problem: Create a box and whiskers plot and determine the appropriate measure of central tendency. Enter data from the data table. Calculate the average weight of a bear cub at various stages of development.

# A Weighty Issue

Data table

| CUB | 5 DAYS | 45 DAYS | 85 DAYS |
|---|---|---|---|
| 1 | 581.7 | 1939.6 | 2400 |
| 2 | 520.5 | 1588.3 | 2050 |
| 3 | 310.8 | 988.1 | 2600 |
| 4 | 387.4 | 1670.6 | 2650 |
| 5 | 331.6 | 1287.8 | 2700 |
| 6 | 358.7 | 962.3 | 1600 |
| 7 | 311.5 | 1443.5 | 2400 |
| 8 | 408.7 | 1108.5 | 1800 |
| 9 | 369.0 | 1680.0 | 2500 |
| 10 | 364.3 | 1650.0 | 2450 |
| 11 | 393.9 | 1135.8 | 2600 |
| 12 | 364.8 | 1365.8 | 3200 |
| 13 | 348.7 | 1474.9 | 2700 |

Key Strokes:

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind is set for Auto.
2. Highlight STAT and press EXE.
3. Enter each cub's number into List 1 by first entering the number and then pressing EXE.
4. Enter each cub's weight at 5 days into List 2 in the same manner.
5. Enter each cub's weight at 45 days into List 3 in the same manner.
6. Enter each cub's weight at 85 days into List 4 in the same manner.
7. Press F1 and then F6 to enter the Setup for the graph.
8. To set up the box and whisker graph for Stat Graph 1, highlight Graph Type, press F6 and F2. Now highlight XList and press F2. Finally, highlight Outliers and press F1. The screen will look like *figure 1*.

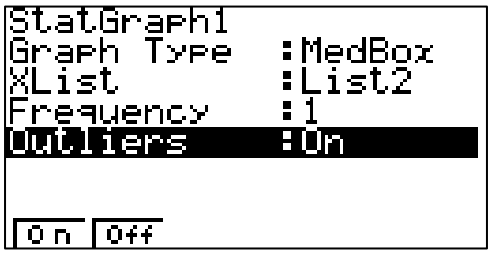



*Figure 1*

9. Press EXE and F1 to create a box and whisker plot with outliers. Press SHIFT and F1 to use the TRACE function along with the arrow keys to determine:

Min: _____ 3rd. Quartile: _____
1st. Quartile: _____ Outliers: _____
Med: _____ Max: _____

10. To set up the box and whisker graph for Stat Graph 2, press EXIT, F6 and F2. Highlight Graph Type, press F6 and F2. Now highlight Xlist and press F3. Finally, highlight Outliers and press F1. The screen will look like *figure 2*.

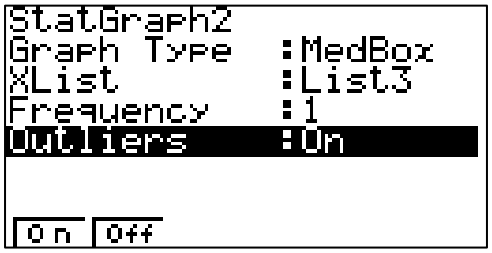



*Figure 2*

11. To set up the box and whisker graph for Stat Graph 3, press EXIT, F6 and F3. Highlight Graph Type, press F6 and F2. Now highlight Xlist and press F4. Finally, highlight Outliers and press F1. The screen will look like *figure 3*.

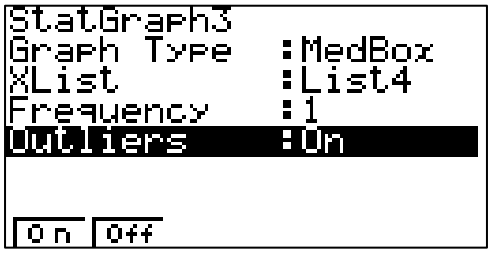



*Figure 3*

12. Press F4, highlight each graph, and press F1 to turn them all on. Press EXE to see the graphs.

13. Press SHIFT and F1 to use the TRACE function along with the arrow keys to show the quartile and median values for each box and whisker plot.

| | 5 Days | 45 Days | 85 Days |
|---|---|---|---|
| Min: | _____ | _____ | _____ |
| Q 1: | _____ | _____ | _____ |
| Med: | _____ | _____ | _____ |
| Q 3: | _____ | _____ | _____ |
| Max: | _____ | _____ | _____ |

14. Sketch your plots below. Remember a graph needs a Title and Axes Labels.

15. To determine the modes for Lists 2, 3, and 4, press EXIT twice. Now press F6 and F2. Enter 1 for the number of lists, press EXE, 2, and EXE to sort List 2. Press F2, enter 1 for the number of lists, press EXE, 3, and EXE to sort List 3. Finally enter 1 for the number of lists, press EXE, 4, and EXE to sort List 4.

16. Review Lists 2, 3, and 4 data to identify the modes.
17. List the modes for each time span.
    5 Days _____
    45 Days _____
    85 Days _____

Analysis questions:

1. Using the weight data, which measure of central tendency best describes the normal weight of cubs for each age?

2. In which quartile do the majority of the weights fall for 5 days, 45 days, and 85 days?

3. Are there any outliers, and if so, what are they?

4. Is there an age where the bear weight values differ more than the others?

## Teacher Notes – A Weighty Issue:

1. The first 5 days bear cub growth will create a box and whisker plot with outliers. See *figure 1.*

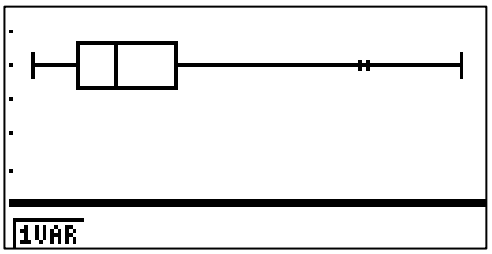



*Figure 1*

2. The second two graphs, 45 days and 85 days do not have outliers. If all three graphs are displayed on the same screen they will show statistical bear cub growth. See *figure 2.*

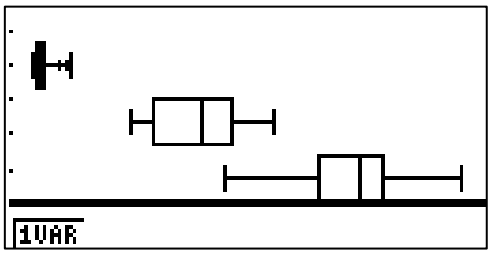



*Figure 2*

3. You can explore further statistics by pressing STAT, arrow right to CALC and selecting 1: 1-Var Stats. Then add the list you wish to be analyzed. See *figure 3* and *figure 4.*

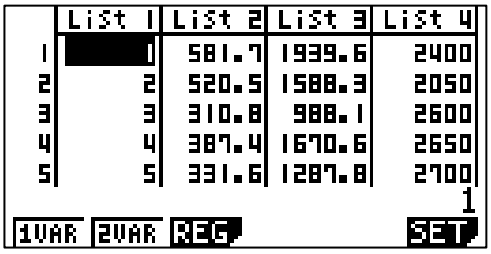



*Figure 3*

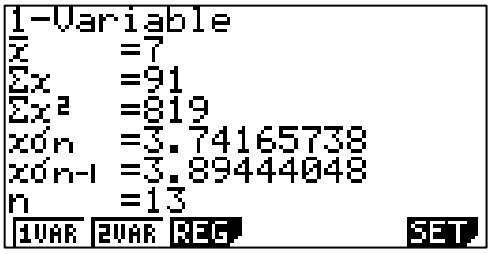



*Figure 4*

# *Can You Bear the Weight?*

Overview:
Students will graph the weight of male and female bear cubs and determine which grows faster.

SOL Connections:
Math 7.5, 7.18, 8.12, and 8.14
Science 6.1, LS.1, LS.8

Background:
Black bears are found in all but a few eastern counties of Virginia, but the densest populations are in the western mountainous part of the state and in the south east corner, mainly the Great Dismal Swamp and surrounding areas. The population of bears is growing and spreading to practically all counties of the Commonwealth. The total number of bears in Virginia may be about 7,000 animals. Bears are nearly always solitary animals, with the exception of family groups (sow with cubs). The male and female have little or no contact other than during mating. Females spend a lot of effort feeding and fattening up before going into hibernation in order to produce healthy cubs. As part of a study conducted by the VA Department of Game and Inland Fisheries and VA Tech, small numbers of female black bears or sows were placed into captivity before hibernation. The sows were pregnant and gave birth to their cubs during the winter hibernation. The purpose of the study was to obtain growth data on cubs in order to be able to assess the health of cubs in the wild population. Similar data is being collected on sows and their cubs in the wild for comparison.

The cubs are born at about 224 grams or about the size of a guinea pig; they grow rapidly. At one year, cubs will grow from the 224 grams to about 22.50 to 31.50 kg. As part of the research project, every 10 days, the sows were immobilized and the cubs were weighed and other growth data recorded. Afterward, cubs were returned to their mothers who then woke up and continued to care for them. Once spring arrived and food was again plentiful, the sow and her cubs were released back into the wild.

More information on black bears and Virginia's Bear Management Plan can be found at http://www.dgif.virginia.gov/wildlife/bear/ .

Question: Which cub will grow faster, the male or female bear cubs?

# Can You Bear the Weight?

Data tables:

WEIGHT DATA FOR 10 MALE CUBS IN GRAMS

| Days | Cub 1 | Cub 2 | Cub 3 | Cub 4 | Cub 5 | Cub 6 | Avg. |
|---|---|---|---|---|---|---|---|
| 5 | 311.5 | 348.7 | 369 | 364.3 | 393.9 | 364.8 | 358.7 |
| 15 | 419.9 | 610.2 | 605.5 | 617.7 | 571.9 | 625. | 575.0 |
| 25 | 668.7 | 910.1 | 933.5 | 904.9 | 771.7 | 889.7 | 846.4 |
| 35 | 987.3 | 1181.1 | 1258.1 | 1165.7 | 941.4 | 1149.1 | 1113.8 |
| 45 | 1443.5 | 1474.9 | 1680 | 1650 | 1135.8 | 1365.8 | 1458.3 |
| 55 | 1583 | 1775.1 | 1850 | 1700 | 1321 | 1596.2 | 1637.6 |
| 65 | 2000 | 2100 | 2100 | 2000 | 1593.1 | 1971.2 | 1960.7 |
| 75 | 2400 | 2700 | 2500 | 2450 | 1600 | 2100 | 2291.7 |
| 85 | | | | | 2600 | 3200 | 2900 |

| Day | Cub 7 | Cub 8 | Cub 9 | Cub 10 | Avg. |
|---|---|---|---|---|---|
| 7 | 599.0 | 508.1 | 390.0 | 435.9 | 483.3 |
| 17 | 1037.2 | 917.9 | 705.0 | 672.9 | 833.3 |
| 27 | 1508.4 | 1377.1 | 1020.0 | 926.0 | 1207.9 |
| 37 | 1999.2 | 1791.8 | 1200.0 | 1116.3 | 1526.8 |
| 47 | 2343. | 2200 | 1410.0 | 1350.9 | 1826 |
| 57 | 2800 | 2600 | 1680.0 | 1542.2 | 2155.6 |
| 67 | 3000 | 2750 | 1750.0 | 1850.0 | 2337.5 |
| 77 | 3000 | 2800 | 1800.0 | 2300.0 | 2475 |

WEIGHT DATA FOR 10 FEMALE CUBS IN GRAMS

| Days | Cub 1 | Cub 2 | Cub 3 | Cub 4 | Cub 5 | Avg. |
|---|---|---|---|---|---|---|
| 1 | 366 | 480 | 287 | 402.2 | 349.2 | 367.9 |
| 11 | 686 | 797 | 450 | 632.5 | 580 | 629.1 |
| 21 | 1095 | 1297 | 637 | 915.8 | 863.4 | 961.6 |
| 31 | 1490 | 1942 | 1299 | 1216 | 1107.6 | 1410.9 |
| 41 | 1879 | 2146 | 1005 | 1499 | 1402.2 | 1586.2 |
| 51 | 2200 | 2550 | 900 | 1716.1 | 1648.9 | 1803 |
| 61 | 2700 | 3000 | 1005 | 2100 | 2050 | 2171 |
| 71 | 3550 | 3850 | | 2500 | 2400 | 3075 |

| Days | Cub 6 | Cub 7 | Cub 8 | Cub 9 | Cub 10 | Avg. |
|---|---|---|---|---|---|---|
| 9 | 634 | 545.9 | 511.7 | 412.4 | 470.7 | 514.9 |
| 19 | 1120 | 1098.5 | 1076.6 | 752.3 | 826.8 | 974.8 |
| 29 | 1590 | 1412.3 | 1373.6 | 1101.8 | 1108.3 | 1317.2 |
| 39 | 2042 | 1513.5 | 1373.9 | 1464.1 | 1566.2 | 1437.4 |
| 49 | 2300 | 1829.5 | 1812.6 | 1774.9 | 1754.6 | 1894.3 |
| 59 | 2650 | 2128.7 | 2384 | 2040.8 | 2022.9 | 2245.3 |
| 69 | 2900 | 2400 | 3400 | 2300 | 2250. | 2650 |
| 79 | 3000 | 3250 | 4250 | 2560 | | 3265 |

Key Strokes

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Auto.
2. Highlight STAT and press EXE.
3. Enter male time periods (days) in List 1.
4. Enter male average weights in List 2.
5. Enter female time periods (days) in List 3 and female average weights in List 4.
   *Figure 1* shows what the data would look like.

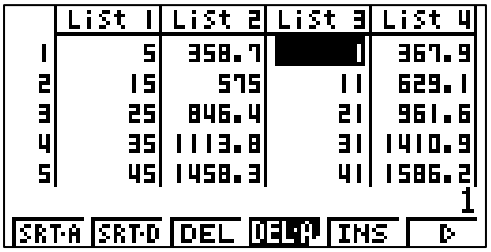



*Figure 1*

6. To be sure that your data is sorted chronologically, press F6 to get to the edit menu. Press F1, enter 2 and press EXE, enter 1 and press EXE, then enter 2 and press EXE. Now sort the female data by pressing F1, entering 2 and pressing EXE, entering 3 and pressing EXE, and finally entering 4 and pressing EXE. Press F6 to get back to the main statistics menu.

7. Press F1 and F6 to get to the graph set up menu.

8. To set up the line graph for Stat Graph 1, highlight Graph Type and press F2. Now highlight Xlist and press F1. Highlight Ylist and press F2. The screen will look like *figure 2*.

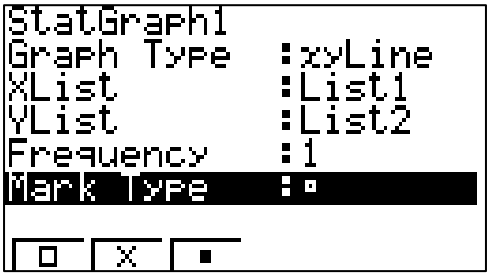



*Figure 2*

9. To set up the line graph for Stat Graph 2, highlight Stat Graph 1 and press F2. Highlight Graph Type and press F2. Now highlight Xlist and press F3. Highlight Ylist and press F4. Move down to Mark Type and press F2. The screen will look like *figure 3*. Press EXE to get back to the main statistics menu.

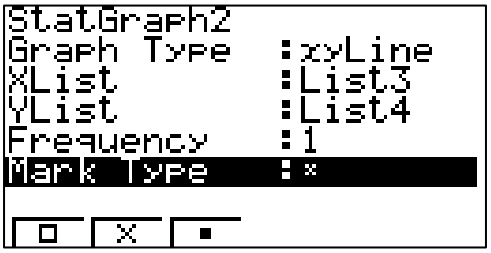



*Figure 3*

10. Press F4 and turn both graphs on by highlighting the graph and pressing F1. Press EXE. The graph should look like *figure 4*.

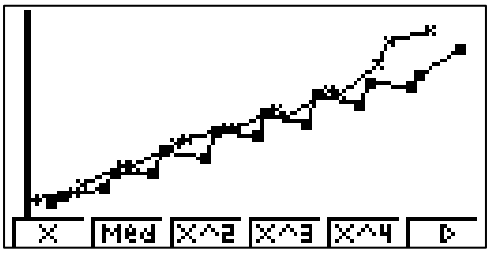



*Figure 4*

Draw your graph here. Remember to title the graph. Each axis should be labeled.

Analysis questions:

1. Is there a difference in growth between male and female cubs?
2. Do they grow at the same rate throughout the 85 days? Are there times when the growth rate slows down?
3. Do they grow faster at the beginning of their life or later? (Hint: look at the slope.)

Extension:

To draw a scatter plot and get the line of best fit, press EXIT and F6 to get to the graph set up screen.

- Using Stat Graph1, highlight Graph Type and press F1.
- Go back up to Stat graph and change to Stat Graph2 by pressing F2.
- Highlight Graph Type and press F1.
- See *figures 1 and 2* below. Press EXE.

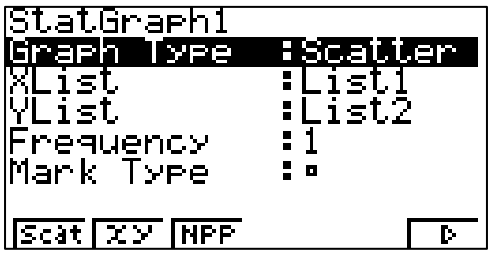



*Figure 1*

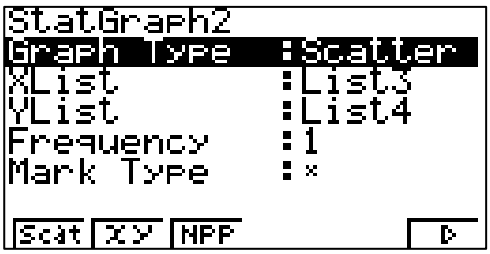



*Figure 2*

- Press F1 to see the scatter plot for Stat Graph1.
- Press F1 to get the line of best fit. Press F5 and EXE to copy this equation into the GRAPH and TABLE Menus. Press F6 to draw the line.
- Press EXIT and F2 to see the scatter plot for Stat Graph2.
- Press F1 to get the line of best fit. Press F5, the down arrow key, and EXE to copy the equation into the GRAPH and TABLE Menus. Press F6 to draw the line.

# Teacher Notes – Can You Bear the Weight?

1. The student graph will look like *figure 1* below. Notice that the female growth is faster in the final days.

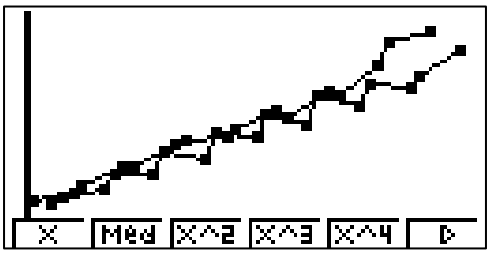



*Figure 1*

2. Since this is authentic data, the mother bears could not all be sedated in order to remove the cubs on the same day, so the data is from alternating days. There were more bears involved in the study. The ten bears selected for the activity are a representation of the total data.

3. The slope of the line represents the growth rate and the y intercept represents the first weight measurement. If you are examining the equation, press the EXIT and 5 to see the calculator generated equations. It may be a good idea to have the students set the calculator to 1 decimal place to avoid large insignificant numbers in the equation. To do this press SHIFT, then MENU and use the arrow keys to highlight Display. Press F1, F2 and EXE to complete the setup.

4. Line of best fit and scatter plot for cub data *figure 2* below

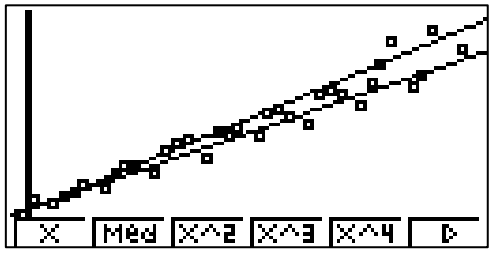



*Figure 2*

# *Deer Population Growth*

Overview:
This activity measures potential growth of a deer population uses data from a hypothetical deer herd as well as data from Virginia's early deer restocking efforts.

SOL Connections:
Math 7.5, 7.18, 8.12
Science LS.1, LS.8, LS.11, LS.12

Background:
Deer had disappeared from western Virginia at the turn of the 20th century. Unregulated hunting and the loss of habitat had eliminated a large portion of the herd. The Department of Game and Inland Fisheries began restoration of the deer herd in1931 by capturing deer in other states and releasing them in Virginia, until 1950. Restocking began again in the late 1960s and early 1970s with deer from established herds within Virginia.

In the southwestern county of Russell there were no resident deer before the department started restocking and transplanting deer. Russell County received a total of 96 deer from 1933 - 1969. The deer season opened in Russell in 1952, with a short "bucks only" (male deer) season. The number of deer taken in Russell County since 1947 can be found at
http://www.dgif.virginia.gov/hunting/va_game_wildlife/deer_harvest.asp?temporalFilter=1994&disp=null

Without any controls on the population, a deer herd will quickly fill the available habitat. Once the total number of deer has passed carrying capacity of the habitat they begin to destroy their habitat. The activity below makes several assumptions: 1) The habitat quality and quantity remain constant, i.e. there has been no further human development in the area since stocking. 2) No deer are hit by vehicles, killed by stray dogs, or die from disease. 3) Hunting is the only possible source of mortality in the herd. These factors that affect the population are called ***limiting factors*** and normally exert some control over any population. The Department of Game and Inland Fisheries manages the size of Virginia's deer herd by allowing citizens to hunt deer and limit the number each hunter may take.

Problem: How does the deer population in Russell County change overtime? Will hunting affect the population?

# Deer Population Growth

| Year Stocked | Number Stocked |
|---|---|
| 1933 | 2 |
| 1937 | 12 |
| 1968 | 46 |
| 1969 | 36 |

One pair of adult deer, living in a good habitat, can produce two fawns per year.
Fawns are born 50-50 males and females (bucks and does). Fawns mature at two years of age.

Sample Deer Population Growth Data Table:

| Year | Adult M | Adult F | Fawn M | Fawn F | Yr M | Yr F | Total | Harvest of Adult M |
|---|---|---|---|---|---|---|---|---|
| 0 | 11.0.0 | 1 | | | | | 2.0 | |
| 1 | 1 | 1 | 1 | | | | 4.0 | 0.1 |
| 2 | 0.9 | 1 | 1 | 1 | 1 | 1 | 5.9 | 0.1 |
| 3 | 1.8 | 2 | 1 | 1 | 1 | 1 | 7.8 | 0.2 |
| 4 | 2.6 | 3 | 2 | 2 | 1 | 1 | 11.6 | 0.3 |
| 5 | 3.4 | 4 | 3 | 3 | 2 | 2 | 17.4 | 0.3 |
| 6 | 5.0 | 6 | 4 | 4 | 3 | 3 | 25.0 | 0.5 |
| 7 | 7.5 | 9 | 6 | 6 | 4 | 4 | 36.5 | 0.8 |
| 8 | 10.8 | 13 | 9 | 9 | 6 | 6 | 53.8 | 1.1 |
| 9 | 15.7 | 19 | 13 | 13 | 9 | 9 | 78.7 | 1.6 |
| 10 | 23.1 | 28 | 19 | 19 | 13 | 13 | 115.1 | 2.3 |
| 11 | 33.8 | 41 | 28 | 28 | 19 | 19 | 168.8 | 3.4 |
| 12 | 49.4 | 60 | 41 | 41 | 28 | 28 | 247.4 | 4.9 |
| 13 | 72.5 | 88 | 60 | 60 | 41 | 41 | 362.5 | 7.2 |
| 14 | 106.2 | 129 | 88 | 88 | 60 | 60 | 531.2 | 10.6 |
| 15 | 155.6 | 189 | 129 | 129 | 88 | 88 | 778.6 | 15.6 |
| 16 | 228.1 | 277 | 189 | 189 | 129 | 129 | 1141.1 | 22.8 |
| 17 | 334.2 | 406 | 277 | 277 | 189 | 189 | 1672.2 | 33.4 |
| 18 | 489.8 | 595 | 406 | 406 | 277 | 277 | 2450.8 | 49.0 |
| 19 | 717.8 | 872 | 595 | 595 | 406 | 406 | 3591.8 | 71.8 |
| 20 | 1052.1 | 1278 | 872 | 872 | 595 | 595 | 5264.1 | 105.2 |
| 21 | 1541.9 | 1873 | 1278 | 1278 | 872 | 872 | 7714.9 | 154.2 |
| 22 | 2259.7 | 2745 | 1873 | 1873 | 1278 | 1278 | 11306.7 | 226.0 |
| 23 | 3311.7 | 4023 | 2745 | 2745 | 1873 | 1873 | 16570.7 | 331.2 |
| 24 | 4853.5 | 5896 | 4023 | 4023 | 2745 | 2745 | 24285.5 | 485.4 |
| 25 | 7113.2 | 8641 | 5896 | 5896 | 4023 | 4023 | 35592.2 | 711.3 |

Key Strokes

Use the following keystrokes to create a sample graph of deer population growth.

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Manual.

2. Highlight STAT and press EXE.

3. Enter the Year Number data into List 1, the Total Population into List 2, and Harvest into List 3 (put in 0 for the harvest of Year 0).

4. Press F1 and F6 to get to the graph set up menu. To set up a scatter plot for Stat Graph 1, highlight Graph Type and press F1. Now highlight Xlist and press F1. Highlight Ylist and press F2. The screen will look like *figure 1* at the right. Press EXE.

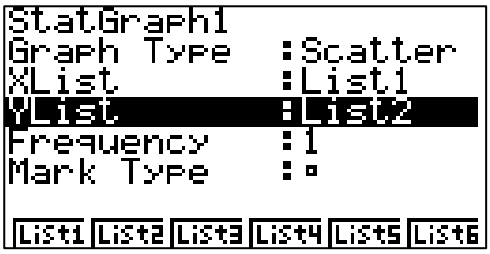



*Figure 1*

5. Look at your data to determine:
   X min _____, X max _____, X scale _____
   Y min _____, Y max _____, Y scale _____

6. Press SHIFT and F3 to get to the window set up and replace all the numbers with your correct values. To change the values, highlight the given value, enter the new value and press EXE. Use the arrow keys to get to the next value to be changed. Press EXE when you have changed all the values necessary.

7. Press F1 twice to see the graph. If the bottom is covered by the menu bar, press the down arrow key until you can see the whole graph.

8. Press SHIFT and F1 to use TRACE to help you graph the function.

9. The curve of the data suggests that this is an exponential relationship. To create a line of best fit, press F6 and F2. Press F5 and EXE to copy the equation into Y1= in the TABLE Menu. Now press F6 to draw the curve.

10. Press EXIT and F6 to get to the graph set up menu. To set up a scatter plot for Stat Graph 2, press F2, highlight Graph Type and press F1. Highlight Xlist and press F1. Now highlight Ylist and press F3. Finally, highlight Mark Type and press F2. The screen will look like *figure 2* at the right. Press EXE.

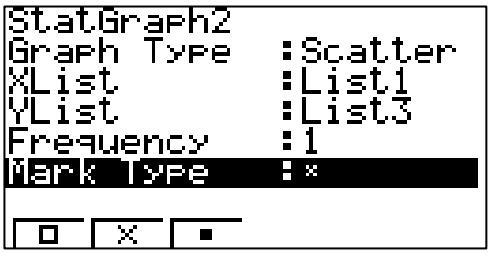



*Figure 2*

11. Look at your data to determine:
    X min _____, X max _____, X scale _____
    Y min _____, Y max _____, Y scale _____

12. Press SHIFT and F3 to get to the window set up and replace all the numbers with your correct values. To change the values, highlight the given value, enter the new value and press EXE. Use the arrow keys to get to the next value to be changed. Press EXE when you have changed all the values necessary.

13. Press F1 twice to see the graph. If the bottom is covered by the menu bar, press the down arrow key until you can see the whole graph.

14. Press SHIFT and F1 to use TRACE to help you graph the function.

15. The curve of the data suggests that this is an exponential relationship. To create a line of best fit, press F6 and F2. Press F5 and EXE to copy the equation into Y2= of the TABLE Menu. Now press F6 to draw the curve.

16. Press the Menu key, highlight TABLE, and press EXE. To set the range for the table, press F4, enter the beginning value and press EXE, enter the ending value and press EXE, and enter the interval for the table and press EXE twice. Press F6 to see the table. Use the table and the down and up arrow keys to determine the answers to the following questions.

Analysis Questions

1. How many deer would be in this herd at the end of five years? _____ Ten years? _____

2. What would be the herd size in 25 years?_____ In 30 years?_____

3. If hunters harvest 10 percent of the mature bucks each year, how many will they harvest the third year?_____ The fifth year?_____ The tenth year?_____

4. Why are your figures not really "true-to-life"?

5. In the real world, what limiting factors can affect the size of a deer herd?

# Teacher Notes - Deer Population Growth:

1. Students can find answers on the data table or use TRACE and the arrow keys to find answers on the graph. To use the table function, press MENU, highlight the TABLE Icon and press EXE. To set up the range, press F5 , enter the starting value and press EXE, enter the ending value and press EXE, and then press EXE again. Press F6 to see the table.

2. The exponential graph for year and deer population is below. (*Figure 1)*

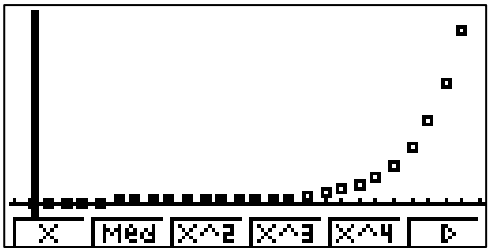



*Figure 1*

3. The exponential graph for the year and harvest is below. (*Figure 2)*

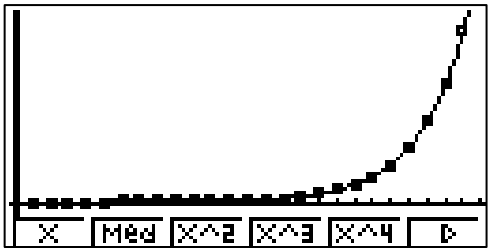



*Figure 2*

4. If you want to look at the equations for the line of best fit, go to the GRAPH Menu. If you want more manageable numbers, press SHIFT MENU, scroll down to DISPLAY, and select 1 or 2 decimal places before doing the line of best fit calculations.

# *Flying High with Fledglings*

Overview:
Students will create a graph of the number of nests and fledglings of bald eagles in Virginia and make inferences on the reasons behind the growth curve.

SOL Objectives:
Math 7.18, 8.3, 8.12, 8.14
Science 6.1, 6.9, LS.1, LS.7, LS.11, LS.12

Background:
The bald eagle became our national symbol in 1782. As our national symbol, it holds a special place in the hearts of our citizens. Even though the bald eagle has been protected from direct harm by people since the Bald Eagle Protection Act of 1940, its habitat was not protected. By the 1960's the eagle population began to seriously decline until 1967, when it was placed on the U.S. Endangered Species List. The eagle was removed from the list on June 28, 2007. On The decline was the result of DDT poisoning, a pesticide that caused the shells of the eggs to be thin and the embryos to develop improperly. The use of DDT in the United States was banned in 1972.

The Endangered Species Act provided protection of any eagle's nest site and surrounding habitat. In 1977, the Virginia Department of Game and Inland Fisheries, (DGIF) began tracking the number of nests and the number of young fledged. Eagles lay 1 to 3 eggs each year during their reproductive life. Since eagles begin nesting in late winter, biologists are able to fly over the nests and count the number of young before the leaves appear on the trees. Later in the year, boat trips counted the number of juvenile and adult birds along Virginia's tidal rivers. The data table on page 24, shows the number of nests and the number of young fledged.

The table that follows shows a recovering population of eagles. The population will begin to level off once the carrying capacity is reached. Carrying capacity is the number of individuals that a given ecosystem can support during the year. Several limiting factors determine the number of eagles an area can support, including the availability of large trees capable of supporting nests, the distance to a river or other source of food, and the frequency of disturbance by outside factors such as boats or people walking near the nest site. Mated pairs tend to be territorial around their nests and will defend their nest site from other birds. They will continue to use the same nest year after year, adding more sticks each winter until the nest may weigh close to 100 pounds.

Eagles will congregate in feeding areas along the rivers and other areas where there is a plentiful food source. The sudden availability of a food source such as a fish kill or other carrion can be detrimental to the population if that food source is contaminated by pesticides or another poison. Eagles are capable of flying long distances during any given day; or an area may host a large number of birds one week and a small number the following week. The ability to travel long distances to a food source may cause a sudden decrease in the population along a river or in a region.

Problem:
Determine if there is a relationship between the number of eagle fledglings and improved environmental conditions. Did the number of eagles increase with the banning of the pesticide DDT? What other factors may have contributed to the number of eagles nesting in Virginia?

# Flying High with Fledglings

Data Table

Eagle Nest's and Fledglings by Year

| Date | Year | Active Nests | Young Fledged |
|---|---|---|---|
| 1977 | 1 | 31 | 18 |
| 1978 | 2 | 36 | 18 |
| 1979 | 3 | 34 | 20 |
| 1980 | 4 | 35 | 35 |
| 1981 | 5 | 39 | 40 |
| 1982 | 6 | 45 | 40 |
| 1983 | 7 | 52 | 51 |
| 1984 | 8 | 60 | 57 |
| 1985 | 9 | 65 | 84 |
| 1986 | 10 | 66 | 83 |
| 1987 | 11 | 73 | 107 |
| 1988 | 12 | 80 | 118 |
| 1989 | 13 | 92 | 88 |
| 1990 | 14 | 104 | 142 |
| 1991 | 15 | 110 | 153 |
| 1992 | 16 | 131 | 141 |
| 1993 | 17 | 149 | 172 |
| 1994 | 18 | 144 | 158 |
| 1995 | 19 | 154 | 223 |
| 1996 | 20 | 180 | 243 |
| 1997 | 21 | 214 | 321 |
| 1998 | 22 | 229 | 314 |
| 1999 | 23 | 230 | 326 |
| 2000 | 24 | 270 | 414 |
| 2001 | 25 | 312 | 465 |
| 2002 | 26 | 329 | 501 |
| 2003 | 27 | 371 | 454 |
| 2004 | 28 | 401 | 612 |
| 2005 | 29 | 429 | 657 |
| 2006 | 30 | 469 | 709 |
| 2007 | 31 | 560 | 737 |

## Keystrokes

1. Refer to **Appendix 1**, Calculator Set Up, to prepare the calculator. Be sure the **Stat Wind** in set for **Manual**.
2. Highlight **STAT** and press **EXE**.
3. Enter the **Year Number** data into **List 1** and **Number Fledged** into **List 2**.

4. Press F1 and then F6 to enter the Setup for the graph. To set up the scatter plot for Stat Graph 1, highlight Graph Type and press F1. Now highlight Xlist and press F1. Finally, highlight Ylist and press F2. The screen will look like *figure 1*.

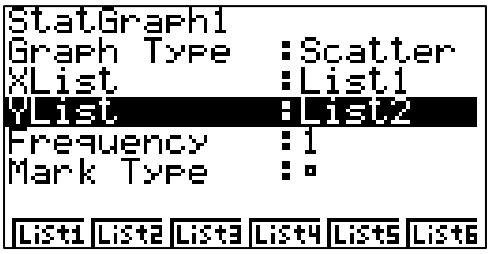



*Figure 1*

5. Look at your year data to determine:
   X min _____, X max _____, X scale _____
   Y min _____, Y max _____, Y scale _____

6. Press SHIFT and F3 to get to the window set up and replace all the numbers with your correct values. To change the values, highlight the given value, enter the new value and press EXE. Use the arrow keys to get to the next value to be changed. Press EXE when you have changed all the values necessary.

7. Press F1 twice to see the graph. If the bottom is covered by the menu bar, press the down arrow key until you can see the whole graph.

8. Press SHIFT and F1 to use TRACE to help you graph the function.

9. The curve of the data suggests that this is an exponential relationship. To create a line of best fit, press F6 and F2. Press F5 and EXE to copy the equation into Y1= in the TABLE Menu. Now press F6 to draw the curve.

## Analysis Questions

1. Looking at the graph, what inferences can you make about the relationship between the number of young and environmental conditions?
2. What are the factors that would affect the population? (Hint: The goal of banning DDT and protection of nest sites and surrounding habitat was to increase the population, was this successful?)
3. Will the population continue to increase indefinitely? Why or why not?

Extensions:

1. Enter the nest data into List 3.

2. Press F1 and then F6 to enter the Setup for the graph. To set up the scatter plot for Stat Graph 2, highlight Graph Type and press F1. Now highlight Xlist and press F1. Finally, highlight Ylist and press F3. Highlight Mark Type and press F2. The screen will look like *figure 1*.

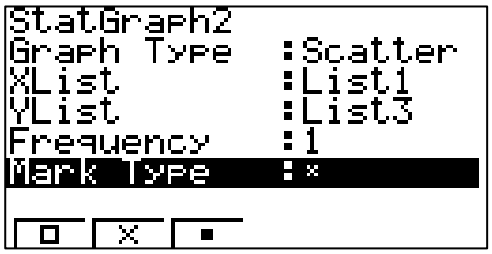



*Figure 1*

3. Press EXE and F2 to see the graph. Press F6 and F2
   To see the line of best fit, press F5 to copy the equation
   Into Y2= of the TABLE function, press EXE, and then F6 to draw the line of best fit.

4. Draw your graph below. Remember a graph needs a title and labeled axes.

5. Why is it important to analyze the increase of nests in addition to the increase of fledglings?

# Teacher Notes – Flying High with Fledglings:

1. The number of fledglings that survive and the number of nests will level off when the population reaches the carrying capacity of the environment. The limiting factors might be available food, nesting sites, number of surviving adults, predation, etc. The population is still expanding exponentially because it has not yet reached carrying capacity.

2. The exponential graph for year and fledglings is below. (*Figure 1)*

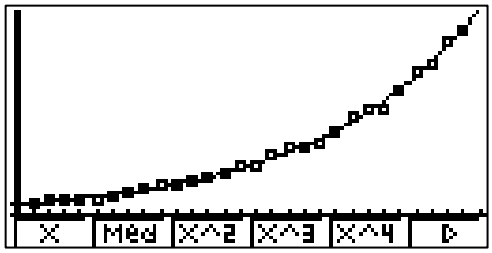



*Figure 1*

3. The exponential graph for the year and nests is below. (*Figure 2)*

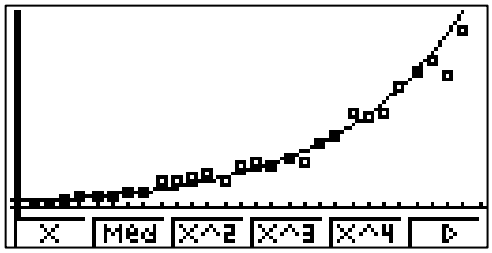



*Figure 2*

4. If you want to look at the equations for the line of best fit press Y= to view them. If you want more manageable numbers, press SHIFT MENU and select 1 or 2 decimal places before doing the line of best fit calculations.

5. IMPORTANT. The students must use year number not year because the years are beyond the graphing limits of the calculator screen.

# *Hey Mister, How Much is That Fish?*

Overview:
Students will use math to determine the cost of raising and releasing one brook trout into a Virginia stream.

SOL Connections:
Math: 7.18, 8.14,
Science: 6.1, 6.7, LS.1, LS.4, LS.12

Background:
Many streams in Virginia's mountains can no longer produce breeding populations of native brook trout. The riparian buffers or stream edges were destroyed by timber practices, farming or construction before regulations protecting these fragile ecosystems were put into place. Without trees to shade the stream trout could not survive. The trees prevent silt from entering streams and provide leaf litter for insects to live in. Trout require optimal water temperatures of 50-68 degrees F and minimum dissolved oxygen content of 6.0 parts per million (ppm). There must also be plenty of aquatic insects available for food. Each year the Department of Game and Inland Fisheries raises or houses trout at six fish cultural stations or fish hatcheries in the western portion of the state.

Fish are grown to catchable size in the hatchery and then placed on trucks to be transported to streams with suitable environmental conditions. A list of where the trout are being stocked on any given week can be found on the web site http://www.dgif.state.va.us/fishing/stocking/

In order to fish for trout, anglers must purchase an additional trout stamp or license for $17.00. This additional charge pays for Virginia's "put and take" trout fishery. The effort to improve stream banks and riparian buffers along Virginia's streams is a constant challenge. With improved water conditions, brook trout, along with the introduced rainbow and brown trout species, will be able to reproduce naturally.

Problem:

Determine the cost of producing one trout for restocking and create a circle graph of operational costs for a trout hatchery.

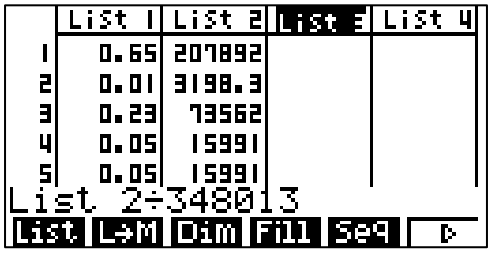
Data Table:

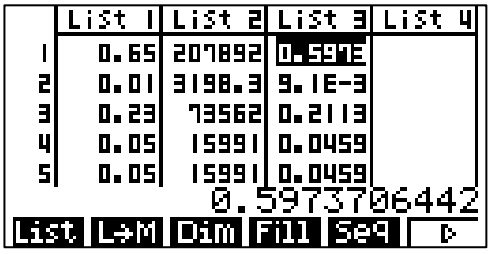
Coursey Springs Hatchery Data 2004

| Data Type | Amount |
|---|---|
| Total Operating Cost | $319,835.00 |
| % salaries | 65 |
| % wages | 1 |
| % feed | 23 |
| % utilities | 5 |
| % vehicles | 5 |
| % maintenance | 1 |
| Number of Trout Released | 348,013 |
| Pounds of Trout Released | 176,752 |

Key Strokes:

1. Refer to Appendix I, Calculator Set Up, to prepare the calculator. Be sure the STAT Wind is set for Auto.
2. Highlight STAT and press EXE.
3. Enter the percent for each operating cost as a decimal into List 1.
4. Move the cursor to the top of the next column and highlight List 2.
5. Press OPTN, F1, F1, 1, x (the times sign), 319835 (the total operational cost), and then EXE.
6. Now move the cursor to the top of the third column and highlight List 3.
7. Press OPTN, F1, F1, 2, ÷, 348013 (the number of trout released), and then EXE.




8. Now move the cursor to the top of the fourth column and highlight List 4.
9. Press OPTN, F1, F1, 2, ÷, 176752 (the pounds of trout released), and then EXE.
10. Press Menu, highlight RUN, and press EXE.
11. To find the cost of raising one hatchery produced trout, press OPTN, F1, F6, F6, F1, F6, F1, 3, and EXE. To get the next sum, press F6, F6, F1, F6, F1, 4, and EXE.
12. Enter your results below.

Cost for Each Trout Produced: _____
Cost per Pound for Each Trout: _____

Analysis Questions:

1. What is the cost to release one hatchery produced trout?

2. In some Virginia streams anglers are allowed to keep only four fish and they must be 12 inches in length. A citizen pays $17.00 for a Fishing License and another $17.00 to fish for trout in stocked trout streams. Assuming that an angler catches his/her limit of fish, how many days must be fished before the angler breaks even?

Extensions:

1. Use the "pounds of trout released" data to create a circle graph of hatchery expenses for one pound of trout.

2. Use the data table for the Montebello Hatchery to create a list and circle graph for hatchery expenses for one fish and one pound of fish.

Data Table

Montebello Hatchery Data 2004

| Data Type | Amount |
|---|---|
| Total Operating Cost | $145,998.00 |
| % salaries | 48 |
| % wages | 8 |
| % feed | 8 |
| % utilities | 4 |
| % vehicles | 18 |
| % maintenance | 14 |
| Number of Trout Released | 141,921 |
| Pounds of Trout Released | 61,119 |

# Teacher Notes – Hey Mister, How Much Is That Fish?

1. The list screen shot for the Coursey Springs Hatchery is below.

| | List 1 | List 2 | List 3 | List 4 |
|---|---|---|---|---|
| 1 | 0.65 | 207892 | 0.5973 | 1.1761 |
| 2 | 0.01 | 3198.3 | 9.1E-3 | 0.018 |
| 3 | 0.23 | 73562 | 0.2113 | 0.4161 |
| 4 | 0.05 | 15991 | 0.0459 | 0.0904 |
| 5 | 0.05 | 15991 | 0.0459 | 0.0904 |

1.176183296

List L→M Dim Fill Seq ▷

Sum List 3
0.9190317603
Sum List 4
1.809512764

List L→M Dim Fill Seq ▷

2. The cost to raise one fish at the Coursey Springs Hatchery is $0.92
3. The activity can also be completed using a standard spreadsheet application.

Extensions:

These are the Montebello Hatchery table and summation screens. The cost per fish is $1.02. The cost per pound of fish is $2.39

| | List 1 | List 2 | List 3 | List 4 |
|---|---|---|---|---|
| 1 | 0.48 | 70079 | 0.4937 | 1.1465 |
| 2 | 0.08 | 11679 | 0.0822 | 0.191 |
| 3 | 0.08 | 11679 | 0.0822 | 0.191 |
| 4 | 0.04 | 5839.9 | 0.0411 | 0.0955 |
| 5 | 0.18 | 26279 | 0.1851 | 0.4299 |

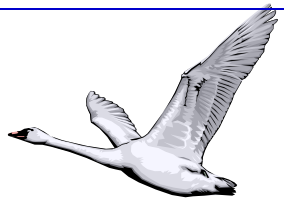
1.146599912

List L→M Dim Fill Seq ▷

Sum List 3
1.02872725
Sum List 4
2.388749816

List L→M Dim Fill Seq ▷

# *How Far is Home?*



Overview: Tundra swans migrate long distances to their summer and wintering grounds. Students determine how far a swan can travel in one season.

SOL Connections:
Math: 7.8, 8.12
Science: 6.1, LS.1, LS.11

Background:
The tundra swan is the largest species of waterfowl that travels to Virginia for the winter months. The population of tundra swans dropped to dangerously low levels in the early 1900s, the species has successfully recovered throughout most of their range.

During the winters of 2001 and 2002, the Virginia Department of Game and Inland Fisheries, along with our neighboring states, placed satellite transmitters on tundra swans in order to determine the birds' migration route. The transmitters should last for 1.5 to 2 years, although some swans loose their transmitters along the way or were not successful in completing the migration. It is critical to know where migratory species such as tundra swans migrate to so that both of their habitats, summer and winter, can best be managed to protect the health of the population.

The tundra swans that winter along the east coast in the Chesapeake Bay region nest in tundra habitats across northern Canada and Alaska. The swans travel a long distance between these two locations. Sometimes the swans take a break along the way, either on the trip north while they wait for the spring thaw or on the way south when they are with their young and need to stop and rest. Waterfowl, such as geese, ducks and swans have historical staging areas where large numbers of birds gather before making the next portion of the trip. These areas usually have abundant food and water supplies that can sustain a large flock. Swans feed on grasses, aquatic vegetation and small grains such as corn, wheat, and soybeans. The U.S. Fish and Wildlife Service, the state wildlife agencies across the United States have established numerous Wildlife Refuges in some of these important staging areas.

You can see the migration paths, nesting locations and diaries of three tundra swans that were captured and tagged in Virginia on the Department of Game and Inland Fisheries web site at http://www.dgif.virginia.gov/wildlife/swan/index.html . There are maps of other swans from previous years in the archived section.

A data table for three of the swans during one migration cycle follows.

Problem:
Determine how far and how long it takes for three swans to migrate, then graph and compare their migration journeys.

Teacher Notes – How Far is Home?

Data Table:

| Swan ID Number | Start Date Record | End Date Record | Total Days | Distance Traveled | Total distance Traveled (mi.) |
|---|---|---|---|---|---|
| 33888 | 4/22/03 | 4/30/03 | | 388.72 mi. N | 338.72 |
| 33888 | 5/01/03 | 5/05/03 | | 496.39 mi. N | 885.11 |
| 33888 | 5/06/03 | 5/13/03 | | 0 mi. - resting | 885.11 |
| 33888 | 5/14/03 | 5/18/03 | | 583 mi. N | 1468.10 |
| 33888 | 5/19/03 | 9/19/03 | | 0 mi. – nesting | 1468.10 |
| 33888 | 9/20/03 | 9/27/03 | | 1379.17 mi. S | 2847.30 |
| 33888 | 9/28/03 | 11/01/03 | | 0 mi. - resting | 2847.30 |
| 33888 | 11/02/03 | 11/05/03 | | 617.81 mi. S | 3465.10 |
| Total days in each direction → | 27 North<br>47 South | | Total distance each direction → | 1468.11 miles North<br>1996.98 miles South | |
| 33894 | 3/29/03 | 4/02/03 | | 621.69 mi. N | 621.69 |
| 33894 | 4/03/03 | 4/27/03 | | 0 mi. - resting | 621.69 |
| 33894 | 4/28/03 | 5/05/03 | | 376.72 mi. N | 998.41 |
| 33894 | 5/06/03 | 5/26/03 | | 0 mi. - resting | 998.41 |
| 33894 | 5/27/03 | 5/30/03 | | 529.33 mi. N | 1527.70 |
| 33894 | 5/31/03 | 9/22/03 | | 0 mi. - nesting | 1527.70 |
| 33894 | 9/23/03 | 9/30/03 | | 1252.78 mi. S | 2780.60 |
| 33894 | 10/01/03 | 12/09/03 | | 0 mi. - resting | 2780.60 |
| 33894 | 12/10/03 | 12/13/03 | | 662.23 mi. S | 3442.80 |
| Total days in each direction → | | | Total distance each direction → | | |
| 33893 | 4/04/03 | 4/12/03 | | 731.66 mi. N | 731.66 |
| 33893 | 4/13/03 | 4/25/03 | | 0 mi. - resting | 731.66 |
| 33893 | 4/26/03 | 5/03/03 | | 328.69 mi. N | 1060.40 |
| 33893 | 5/04/03 | 5/20/03 | | 0 mi. - resting | 1060.40 |
| 33893 | 5/21/03 | 6/01/03 | | 1115.04 mi. N | 2175.40 |
| 33893 | 6/02/03 | 9/17/03 | | 0 mi. -nesting | 2175.40 |
| 33893 | 9/18/03 | 9/26/03 | | 1224.28 mi. S | 3399.70 |
| 33893 | 9/27/03 | 12/09/03 | | 0 mi. resting | 3399.70 |
| 33893 | 12/10/03 | 12/21/03 | | 903.55 mi. S | 4303.30 |
| Total days in each direction → | | | Total distance each direction → | | |

Keystrokes

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Auto.
2. Highlight STAT and press EXE.
3. Enter Total Days for swan 33888 in List 1.
4. Enter Total Distance Traveled for swan 33888 in List 2.
5. Enter Total Days for swan 33894 in List 3.
6. Enter Total Distance Traveled for swan 33894 in List 4.
7. Enter Total Days for swan 33893 in List 5.
8. Enter Total Distance Traveled for swan 33893 in List 6.

9. Press F1 and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 1, highlight Graph Type and press F2. Now highlight Xlist and press F1. Highlight Ylist and press F2. The screen will look like *figure 1* at the right. Press EXE.

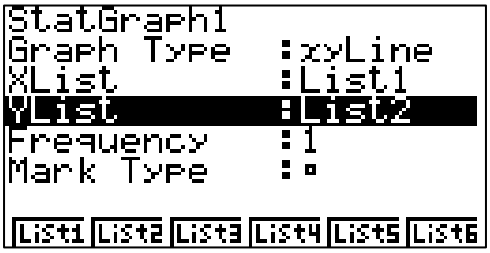



*Figure 1*

10. Press EXIT and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 2, press F2, highlight Graph Type and press F2. Highlight Xlist and press F3. Now highlight Ylist and press F4. Finally, highlight Mark Type and press F2. The screen will look like *figure 2* at the right. Press EXE.

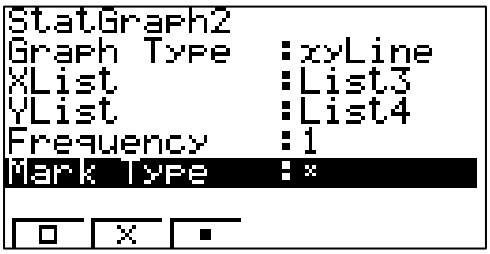



*Figure 2*

11. Press EXIT and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 3, press F3, highlight Graph Type and press F2. Highlight Xlist and press F5. Now highlight Ylist and press F6. Finally, highlight Mark Type and press F3. The screen will look like *figure 3* at the right. Press EXE.

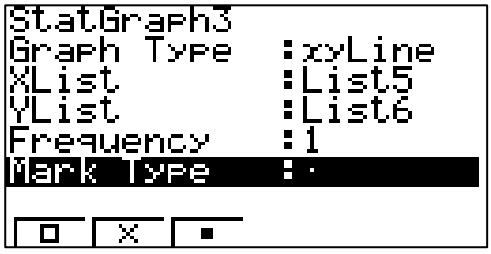



*Figure 3*

12. Press F4 and turn all of the graphs on by highlighting the graph and pressing F1. The screen should look like *figure 4*. Press EXE to see the graph.

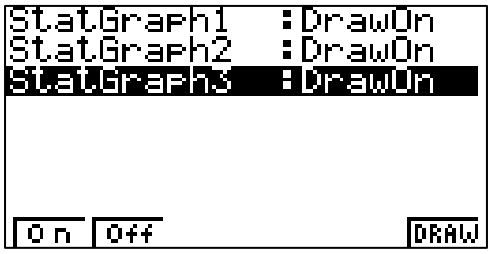
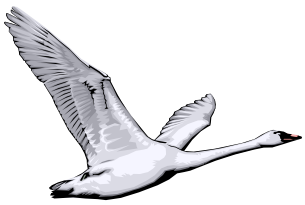
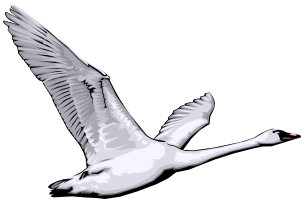
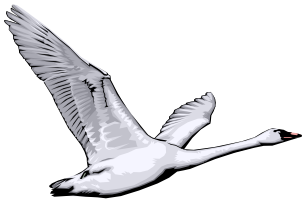



*Figure 4*

13. Press SHIFT and F1 to use the TRACE function and the arrow keys to sketch your plot below. Remember a graph needs a title and labeled axes.







Teacher Notes – How Far is Home?

Data Table:

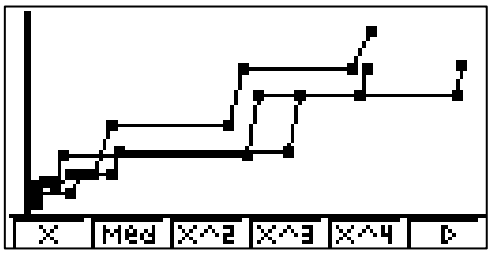
| Swan ID Number | Start Date Record | End Date Record | Total Days | Distance Traveled | Total distance Traveled (mi.) |
|---|---|---|---|---|---|
| 33888 | 4/22/03 | 4/30/03 | 9 | 388.72 mi. N | 338.72 |
| 33888 | 5/01/03 | 5/05/03 | 14 | 496.39 mi. N | 885.11 |
| 33888 | 5/06/03 | 5/13/03 | 22 | 0 mi. - resting | 885.11 |
| 33888 | 5/14/03 | 5/18/03 | 27 | 583 mi. N | 1468.10 |
| 33888 | 5/19/03 | 9/19/03 | 151 | 0 mi. – nesting | 1468.10 |
| 33888 | 9/20/03 | 9/27/03 | 159 | 1379.17 mi. S | 2847.30 |
| 33888 | 9/28/03 | 11/01/03 | 194 | 0 mi. - resting | 2847.30 |
| 33888 | 11/02/03 | 11/05/03 | 198 | 617.81 mi. S | 3465.10 |
| Total days in each direction → | 27 North<br>47 South | | Total distance each direction → | 1468.11 miles North<br>1996.98 miles South | |
| 33894 | 3/29/03 | 4/02/03 | 5 | 621.69 mi. N | 621.69 |
| 33894 | 4/03/03 | 4/27/03 | 30 | 0 mi. - resting | 621.69 |
| 33894 | 4/28/03 | 5/05/03 | 38 | 376.72 mi. N | 998.41 |
| 33894 | 5/06/03 | 5/26/03 | 59 | 0 mi. - resting | 998.41 |
| 33894 | 5/27/03 | 5/30/03 | 63 | 529.33 mi. N | 1527.70 |
| 33894 | 5/31/03 | 9/22/03 | 178 | 0 mi. - nesting | 1527.70 |
| 33894 | 9/23/03 | 9/30/03 | 186 | 1252.78 mi. S | 2780.60 |
| 33894 | 10/01/03 | 12/09/03 | 256 | 0 mi. - resting | 2780.60 |
| 33894 | 12/10/03 | 12/13/03 | 260 | 662.23 mi. S | 3442.80 |
| Total days in each direction → | 63 North<br>82 South | | Total distance each direction → | 1527.70 miles North<br>1915.01 miles South | |
| 33893 | 4/04/03 | 4/12/03 | 9 | 731.66 mi. N | 731.66 |
| 33893 | 4/13/03 | 4/25/03 | 22 | 0 mi. - resting | 731.66 |
| 33893 | 4/26/03 | 5/03/03 | 30 | 328.69 mi. N | 1060.40 |
| 33893 | 5/04/03 | 5/20/03 | 47 | 0 mi. - resting | 1060.40 |
| 33893 | 5/21/03 | 6/01/03 | 59 | 1115.04 mi. N | 2175.40 |
| 33893 | 6/02/03 | 9/17/03 | 167 | 0 mi. -nesting | 2175.40 |
| 33893 | 9/18/03 | 9/26/03 | 176 | 1224.28 mi. S | 3399.70 |
| 33893 | 9/27/03 | 12/09/03 | 250 | 0 mi. resting | 3399.70 |
| 33893 | 12/10/03 | 12/21/03 | 262 | 903.55 mi. S | 4303.30 |
| Total days in each direction → | 59 North<br>95 South | | Total distance each direction → | 2175.40 miles North<br>2127.83 miles South | |

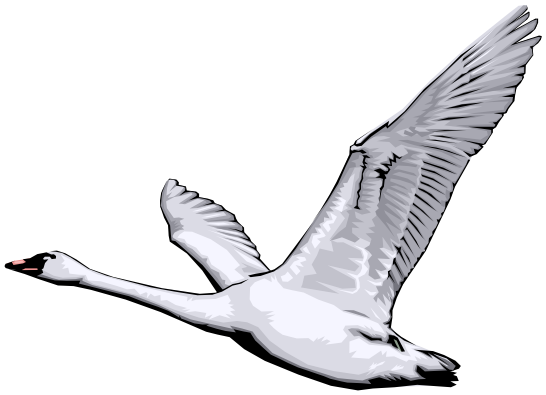
- Swan 33893 flew farthest to its nesting ground. Tundra swans nest in Canada and Alaska.
- Swan 33888 flew back to Virginia the fastest
- For the three swans on the data table, the average distance flown North is 1724 miles; the average distance flown South is 2013 miles.
- Swan 33888 headed East before heading South on the return migration trip

Maps are available on line at http://www.dgif.virginia.gov/wildlife/swan/index.html

| Swan | North (mi./day) | South (mi./day) | Total Trip (mi./day) |
|---|---|---|---|
| 33888 | 54 | 45 | 50 |
| 33894 | 75 | 24 | 50 |
| 33893 | 37 | 25 | 31 |

The line graph of the 3 swan migrations below



# *Let's Talk Deer*

Overview: The quality of habitat has an affect on the overall size and health of individual deer. Students graph antler size and infer the relationship between antler growth and habitat quality of two Virginia counties.

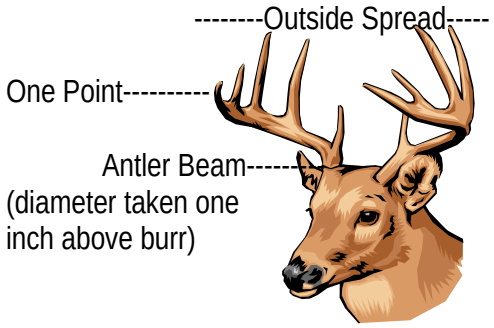
SOL Objectives:
Math 7.18, 8.12
Science 6.9, LS.1, LS.9, LS.10, LS.11, LS.12

Background:
Deer had disappeared from western Virginia at the turn of the 20th century. Unregulated hunting and the loss of habitat had eliminated a large portion of the herd. The Department of Game and Inland Fisheries began restoration of the deer herd in 1931 by capturing deer in other states and releasing them in Virginia until 1950. Restocking began again in the late 1960s and early 1970s with deer from established herds within Virginia.

Without any controls on the population, a deer herd will quickly fill the available habitat. Habitat is more than just the piece of land that the deer occupy. Although there must be ample food, water and shelter in the habitat, the quality of those key components will determine the actual number and health of the animals in the area. The habitat quality in Frederick County is better than the habitat in Caroline County. Frederick County has richer soils that are limestone based and will grow better vegetation that deer need. Frederick County also has more farms which increases the availability of crops and orchard fruit, a favorite food source for deer. In contrast the soil in Caroline County is an acidic mix of sand and clay. Such soils do not support optimal deer habitat. Factors like habitat quality which can affect a population are called ***limiting factors*** and normally exert some control over herd numbers and growth vigor.

Each year, several measurements are recorded from the deer hunted in each county and the numbers are analyzed by the Virginia Department of Game and Inland Fisheries. The antler beam diameter, number of points, and outside spread are measured. We can use the size of the antler beam to infer the size of the deer.

Problem:
How does antler growth compare between two different deer herds in Caroline County and Frederick Count? Which county "grows" healthier deer?



Data table

Yearling (1.5 yrs) Antler Data for Caroline and Frederick Counties in 2000

| Harvest Date | No Points | Beam Diameter in mm | Outside Spread in inches | County Name |
|---|---|---|---|---|
| 17-Nov-00 | 2 | 10 | 6.00 | Caroline |
| 24-Nov-00 | 4 | 20 | 16.25 | Caroline |
| 17-Nov-00 | 4 | 19 | 7.25 | Caroline |
| 22-Nov-00 | 2 | 14 | 4.25 | Caroline |
| 20-Nov-00 | 5 | 14 | 8.00 | Caroline |
| 10-Nov-00 | 3 | 20 | 6.00 | Caroline |
| 06-Nov-00 | 2 | 14 | 7.00 | Caroline |
| 17-Nov-00 | 2 | 10 | 6.00 | Caroline |
| 20-Nov-00 | 5 | 14 | 8.00 | Caroline |
| 20-Nov-00 | 4 | 16 | 6.00 | Caroline |
| 20-Nov-00 | 2 | 13 | 9.25 | Caroline |
| 22-Nov-00 | 2 | 14 | 4.25 | Caroline |
| 20-Nov-00 | 3 | 16 | 9.25 | Caroline |
| 24-Nov-00 | 3 | 17 | 9.00 | Caroline |
| 24-Nov-00 | 2 | 15 | 6.50 | Caroline |
| 24-Nov-00 | 2 | 19 | 9.00 | Caroline |
| 24-Nov-00 | 2 | 12 | 15.00 | Caroline |
| 11-Nov-00 | 3 | 8 | 9.25 | Caroline |
| 22-Nov-00 | 4 | 19 | 9.00 | Caroline |
| 24-Nov-00 | 5 | 15 | 6.00 | Caroline |
| 25-Nov-00 | 3 | 10 | 8.00 | Caroline |
| 25-Nov-00 | 2 | 13 | 6.00 | Caroline |
| 06-Nov-00 | 2 | 14 | 6.75 | Caroline |
| 17-Nov-00 | 2 | 18 | 6.88 | Caroline |
| 20-Nov-00 | 3 | 16 | 8.50 | Caroline |
| 15-Nov-00 | 3 | 16 | 15.50 | Frederick |
| 20-Nov-00 | 2 | 16 | 7.13 | Frederick |
| 20-Nov-00 | 5 | 20 | 10.50 | Frederick |
| 25-Nov-00 | 4 | 17 | 20.00 | Frederick |
| 25-Nov-00 | 2 | 14 | 5.25 | Frederick |
| 17-Nov-00 | 3 | 16 | 6.50 | Frederick |
| 13-Nov-00 | 4 | 16 | 7.00 | Frederick |
| 20-Nov-00 | 2 | 10 | 6.00 | Frederick |
| 16-Nov-00 | 2 | 14 | 7.00 | Frederick |
| 14-Nov-00 | 8 | 17 | 9.00 | Frederick |
| 25-Nov-00 | 2 | 12 | 7.50 | Frederick |
| 20-Nov-00 | 5 | 16 | 7.13 | Frederick |
| 20-Nov-00 | 4 | 15 | 9.38 | Frederick |
| 20-Nov-00 | 2 | 13 | 4.00 | Frederick |
| 20-Nov-00 | 4 | 16 | 9.38 | Frederick |
| 20-Nov-00 | 6 | 26 | 11.38 | Frederick |

| Harvest Date | No Points | Beam Diameter in mm | Outside Spread | County Name |
|---|---|---|---|---|
| 20-Nov-00 | 4 | 19 | 6.50 | Frederick |
| 25-Nov-00 | 7 | 20 | 10.63 | Frederick |
| 24-Nov-00 | 2 | 10 | 3.50 | Frederick |
| 15-Nov-00 | 7 | 29 | 14.25 | Frederick |
| 25-Nov-00 | 7 | 26 | 11.50 | Frederick |
| 25-Nov-00 | 6 | 25 | 10.38 | Frederick |
| 20-Nov-00 | 4 | 16 | 4.00 | Frederick |
| 20-Nov-00 | 4 | 15 | 4.00 | Frederick |

Question:
Does habitat affect the size of antlers in deer yearlings?

Keystrokes

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Auto.
2. Highlight STAT and press EXE.
3. Enter Deer Beam Diameter for Caroline County in List 1.
4. Enter Deer Beam Diameter for Frederick County in List 2.
5. Press F1 and then F6 to enter the Setup for the graph.
6. To set up the box and whisker graph for Stat Graph 1, highlight Graph Type, press F6 and F2. Now highlight XIist and press F1. Finally, highlight Outliers and press F1. The screen will look like *figure 1*.

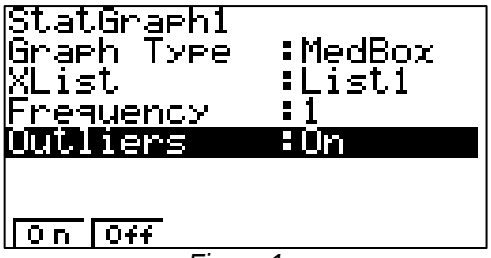



*Figure 1*

7. Press EXIT and F1 to create a box and whisker plot with outliers. Press SHIFT and F1 to use TRACE and the arrow keys to determine:

| | | | |
|---|---|---|---|
| Min: | _____ | 3rd. Quartile: | _____ |
| 1st. Quartile: | _____ | Outliers: | _____ |
| Med: | _____ | Max: | _____ |

8. Press EXIT. To set up the box and whisker graph for Stat Graph 2, highlight Graph Type, press F6 and F2. Now highlight XIist and press F2. Finally, highlight Outliers and press F1. The screen will look like *figure 2*.

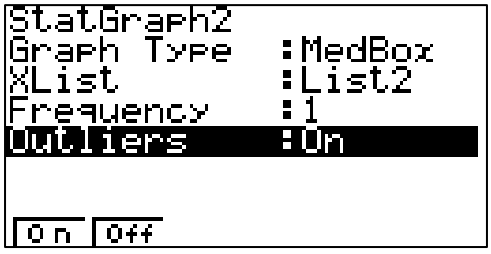
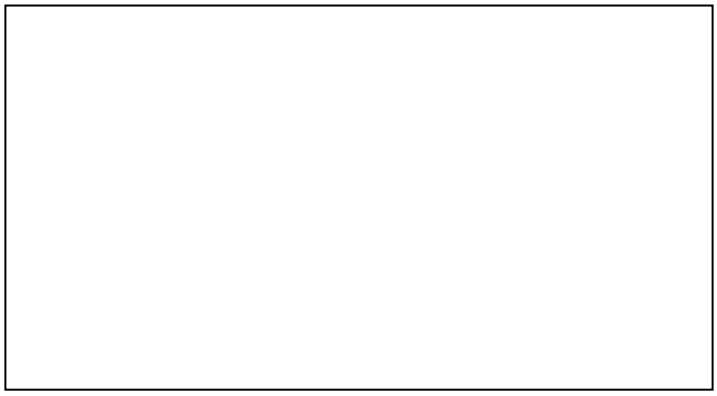



*Figure 2*

9. Press EXE. Now press F4 and turn both Stat Graph1 and Stat Graph2 on by highlighting them and pressing F1. Press EXE to create the box and whisker plots with outliers. Press SHIFT and F1 to use TRACE and the arrow keys to show the quartile and median values for each box and whisker plot.

| | Caroline County | Frederick County |
|---|---|---|
| Min: | _____ | _____ |
| Q 1: | _____ | _____ |
| Med: | _____ | _____ |
| Q 3: | _____ | _____ |
| Max: | _____ | _____ |

10. Sketch your plot below. Remember a graph needs a Title and Axes Labels.



13. To determine the modes for List1 and List 2, press EXIT twice and then F6 to get to the edit screen. Now press F2. Enter 1 for the number of lists, press EXE, enter 1, and press EXE to sort List 1. Press F2, enter 1 for the number of lists, press EXE, enter 2, and press EXE to sort List 2.

14. List the modes for each span.

15. Caroline County Deer Beam Diameter _____

16. Frederick County Deer Beam Diameter _____

17. To analyze the measures of central tendency, press F6 to get to the main statistics menu. Press F2, F6, and F1 for List 1 or F2 for List 2.

Analysis questions:

1. Using the beam diameter data, which measure of central tendency best describes the average size deer for each county?

2. In which quartile do the majority of the deer fall for each county?

3. Are there any outliers, and if so, what are they?

4. Are the deer in one county statistically larger than the deer in the other county? What might explain this?

## Teacher Notes – Lets Talk Deer:

1. The size of deer as inferred from its antler beam diameter is statistically larger in Frederick County than in Caroline County. See *figure 1.*

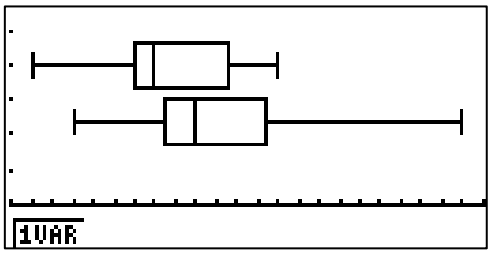



*Figure 1*

2. The deer population in Frederick County has one Outlier. The mode for Caroline County is 14 mm and the mode for Frederick County is 16 mm.

3. You can explore further statistics by pressing F1. Use the Up and Down arrow keys to select the graph you wish to be analyzed. See *figure 3.*

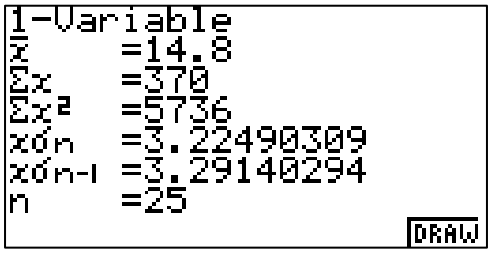



*Figure 3*

# *Let's Talk Turkey*

## Overview:

All wildlife species, including turkey, are dependent upon their habitat. The biotic (living) and abiotic (nonliving) factors in the ecosystem have an influence on the survival of young and adult turkeys. In years when oak trees do not produce abundant acorns, fall or winter survival may be limited to those birds that can find enough additional food sources to replace the calories obtained from acorns.

## SOL Connections:

Math 7.18, 8.12
Science: LS.1, LS.7, LS.9, LS.11

## Background:

Wild turkeys were abundant in colonial times and were a major source of food for early Virginians. Loss of habitat in the early 1900's caused a large decline in Virginia's turkey population. Turkeys can now be found throughout the state after an extensive recovery plan that began in the early 20th century. The population of wild turkeys in Virginia numbers around 180,000 birds.

The Department of Game and Inland Fisheries continuously monitors the ratio of adult to juvenile turkeys and male to female turkeys in order to maintain a stable population. To assist biologists in determining this ratio, fall turkey hunters turn in a breast and wing feather from each bird harvested. This provides the biologists with a random sample of the overall population.

Turkeys feed on a variety of plants and insects during the year. During the fall, acorns make up a large part of their diet. Biologists call the fall fruit, nut and berry production *"mast".* Hard mast is made up of hickory nuts, walnuts and acorns. Soft mast is made up of berries on holly, honeysuckle, blueberries and other soft fruits. By surveying the amount of mast available, biologists have an idea of how many young animals will have enough food to get them through the winter. Each year biologists count the number of acorns on each limb of a sample plot of oak trees to determine the relative abundance of mast. Oak trees tend to produce large number of acorns every two to three years. Spring rains, wind and the amount of summer rainfall can also have an effect on the number of acorns available to turkeys.

An important factor that influences the ratio of juveniles to adults is the amount of rain each spring. Turkeys are ground-nesting birds, and heavy rains will flood out their nests, forcing the hens to begin a new clutch or nest of eggs again. Second or even third clutches are usually smaller then the original clutch. Biologists look at this and many other limiting factors to determine the health of wildlife populations. In this activity we will only look at the mast count.

## Problem:

How does the abundance of an acorn crop influence the population of young wild turkeys that survive each year?

Data Table:

Wild Turkey Age and Sex Composition from Fall Harvest Feather Collections in Virginia.

| Year | Year Number | % Juvenile | % Adult Female | % Adult Male | Sample Size Total of all birds |
|---|---|---|---|---|---|
| 1984 | 1 | 60.9 | 18.6 | 20.5 | 4,483 |
| 1985 | 2 | 61.3 | 17.2 | 21.4 | 5,270 |
| 1986 | 3 | 64.6 | 16.4 | 19.0 | 5,447 |
| 1987 | 4 | 63.6 | 16.1 | 20.3 | 6,599 |
| 1988 | 5 | 61.9 | 17.3 | 20.8 | 4,877 |
| 1989 | 6 | 66.3 | 15.8 | 17.9 | 6,289 |
| 1990 | 7 | 52.0 | 21.9 | 26.1 | 6,986 |
| 1991 | 8 | 63.0 | 17.4 | 19.6 | 4,474 |
| 1992 | 9 | 51.1 | 21.0 | 27.9 | 4,421 |
| 1993 | 10 | 65.1 | 16.8 | 18.1 | 4,329 |
| 1994 | 11 | 60.4 | 17.2 | 22.4 | 5,011 |
| 1995 | 12 | 58.9 | 19.0 | 22.0 | 3,638 |
| 1996 | 13 | 54.9 | 18.7 | 26.4 | 3,650 |
| 1997 | 14 | 45.4 | 24.3 | 30.3 | 3,235 |
| 1998 | 15 | 43.3 | 26.0 | 27.7 | 1,924 |
| 1999 | 16 | 56.4 | 24.3 | 30.3 | 1,899 |
| 2000 | 17 | 55.3 | 18.7 | 26.0 | 1,870 |
| 2001 | 18 | 48.3 | 21.6 | 30.1 | 2,815 |
| 18 yr. avg. | | 57.5 | 19.1 | 23.3 | |
| 5 yr avg. | | 50.3 | 22.1 | 27.5 | |

**Virginia Oak Mast Survey Ratings**
**Mean Number of Acorns per limb**

| Year Number | Year | Avg. # per limb |
|---|---|---|
| 1 | 1984 | 16.8 |
| 2 | 1985 | 36.5 |
| 3 | 1986 | 15.6 |
| 4 | 1987 | 2.8 |
| 5 | 1988 | 24.0 |
| 6 | 1989 | 26.6 |
| 7 | 1990 | 10.2 |
| 8 | 1991 | 22.1 |
| 9 | 1992 | 8.9 |
| 10 | 1993 | 17.9 |
| 11 | 1994 | 18.5 |
| 12 | 1995 | 21.0 |
| 13 | 1996 | 20.5 |
| 14 | 1997 | 7.2 |
| 15 | 1998 | 17.1 |
| 16 | 1999 | 18.8 |
| 17 | 2000 | 18.4 |
| 18 | 2001 | 26.6 |
| | | |
| | Total | 329.5 |
| | # years | 18 |
| | Mean | 18.3 |

Key Strokes

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Auto.
2. Highlight STAT and press EXE.
3. Enter year number from the first table in List 1.
4. Enter percent of juveniles in List 2.
5. Enter state acorn average data from the second table in List 3.
6. Press F1 and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 1, highlight Graph Type and press F2. Now highlight Xlist and press F1. Highlight Ylist and press F2. The screen will look like *figure 1* at the right. Press EXE.

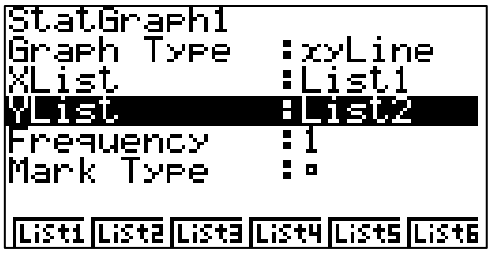



*Figure 1*

7. Press EXIT and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 2, press F2, highlight Graph Type and press F2. Highlight Xlist and press F1. Now highlight Ylist and press F3. Finally, highlight Mark Type and press F2. The screen will look like *figure 2* at the right. Press EXE.

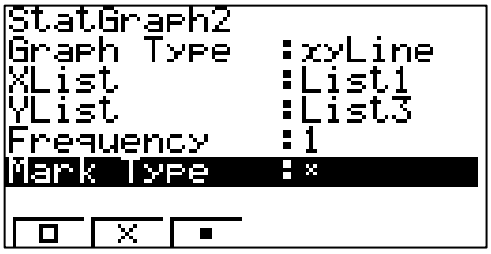



*Figure 2*

8. Press F4 and turn both of the graphs on by highlighting the graph and pressing F1. The screen should look like *figure 3*. Press EXE to see the graph.

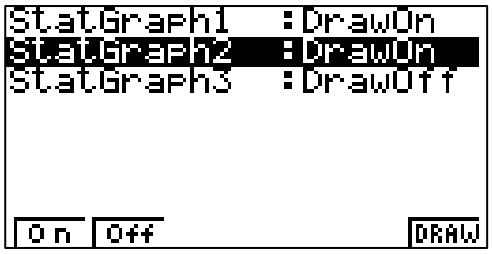


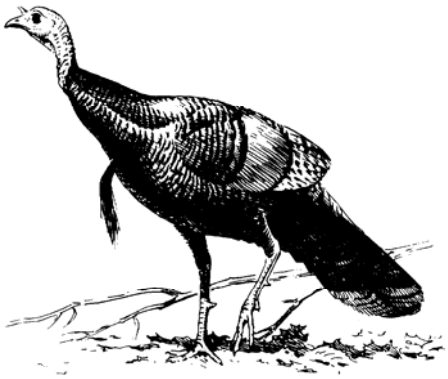

*Figure 3*

9. Press SHIFT and F1 to use the TRACE function and the arrow keys to sketch your plot below. Remember a graph needs a title and labeled axes.

Analysis Questions:

1. Is there a correlation between decreases in juvenile turkey populations and acorn mast for the year? Use examples from your graph to support your answer.

2. Are there years when acorn mast and juvenile turkey populations are not correlated? What might be other factors that would affect juvenile turkey populations?



## Teacher Notes – Let's Talk Turkey:

1. There is a correlation between acorn mast and juvenile turkey populations for years 6 through 14. See *figure 1*.

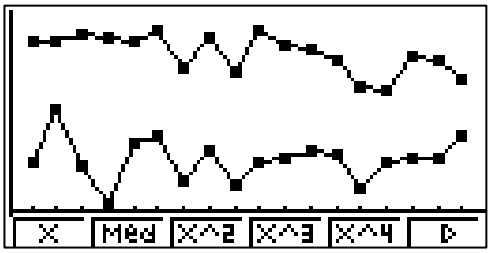
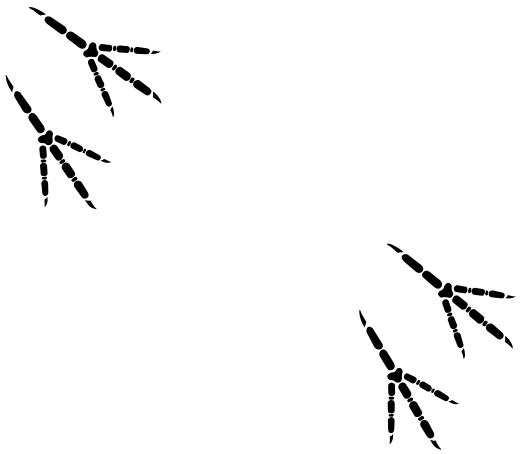



*Figure 1*

2. There is no correlation between acorn mast and the juvenile turkey population for year 3, 15, and 18. This could be due to climate, other food sources or predation.



# *Turkey Families*

Overview:
Wild turkeys can be aged and sexed by their feathers. Using feather information collected by hunters, students will determine the ratio of adult to juvenile birds harvested.

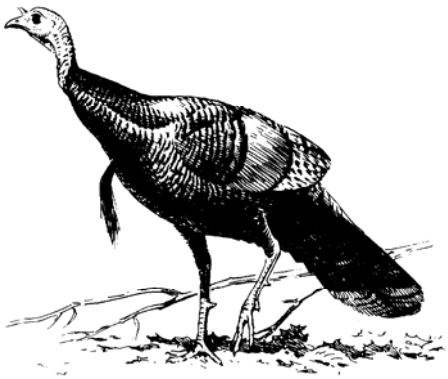
SOL Connections:
Math: 7.18, 8.12
Science: 6.1, LS.1, LS.4, LS.7

Background:
Wild turkeys were abundant in colonial times and were a major source of food for early Virginians. Loss of habitat in the early 1900's caused a large decline in Virginia's turkey population. Turkeys can now be found throughout the state after an extensive recovery plan that began in the early 20th century. The population of wild turkeys in Virginia numbers around 180,000 birds.

The Department of Game and Inland Fisheries continuously monitors the ratio of adult to juvenile turkeys and male to female turkeys in order to maintain a stable population. To assist biologists in determining this ratio, fall turkey hunters turn in a breast and wing feather from each bird harvested. This provides the biologists with a random sample of the overall population.

Breast feathers from female turkeys are brown on the tip and the edge is ragged. Male breast feathers have a black tip with a smooth edge. To determine the age of the turkey, biologists look at a primary or wing feather. Pointed primaries without white barring or stripes on the tip come from juvenile birds. Rounded primaries with barring to the end of the feather are adults. A color graphic of the methods used to age turkeys can be viewed at http://www.dgif.virginia.gov/hunting/va_game_wildlife/index.html .

Problem:
What is the correlation between the numbers of juveniles and the numbers of adult birds over several years? Does the ratio of adult to juvenile turkeys remain stable over a period of years?



Data table: Wild turkey age and sex composition from fall harvest feather collections in Virginia.

| Year | Year Number | % Juvenile | % Adult Female | % Adult Male | Total of birds sampled |
|---|---|---|---|---|---|
| 1984 | 1 | 60.9 | 18.6 | 20.5 | 4,483 |
| 1988 | 5 | 61.9 | 17.3 | 20.8 | 4,877 |
| 1992 | 9 | 51.1 | 21.0 | 27.9 | 4,421 |
| 1997 | 14 | 45.4 | 24.3 | 30.3 | 3,235 |
| 2001 | 18 | 48.3 | 21.6 | 30.1 | 2,815 |
| 18 yr. avg. | | 57.5 | 19.1 | 23.3 | |

Keystrokes

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Auto.
2. Highlight STAT and press EXE.
3. Enter the years for the turkey data in List 1.
4. Enter the percentages of males in List 2.
5. Enter the percentages of females in List 3.
6. Enter the percentages of young in List 4. The screen should look like *Figure 1*.

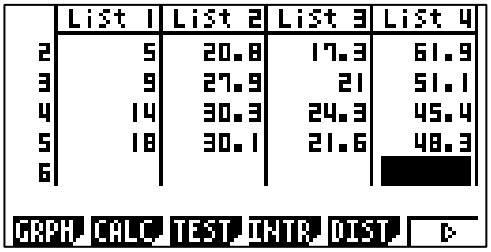



*Figure 1*

7. Press F1 and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 1, highlight Graph Type and press F2. Now highlight Xlist and press F1. Highlight Ylist and press F2. The screen will look like *Figure 2* at the right.

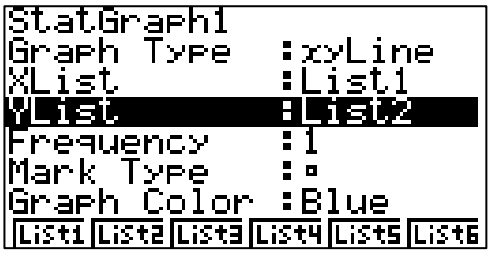



*Figure 2*

8. Use the arrow keys to highlight Stat Graph 1 and press F2 to set up Stat Graph 2. Set up Stat Graph 2 as a similar line graph using List 1 for Xlist and List 3 for Ylist.

9. Use the arrow keys to highlight Stat Graph 2 and press F3 to set up Stat Graph 3. Set up Stat Graph 3 as a line graph using List 1 for Xlist and List 4 for Ylist. Press EXE.

10. To see the graphs for the data, press F4, highlight each of the graphs, and press F1 to turn in on. Now press F6 to see the graphs.

11. Press SHIFT and F1 to use the TRACE function and the arrow keys to sketch your graphs below. Use the up and down arrow keys to select the particular graph that you want to draw. Remember a graph needs a title and labeled axes.

Analysis Questions:

1. How do the numbers of males, females, and young compare within the populations of turkeys graphed?

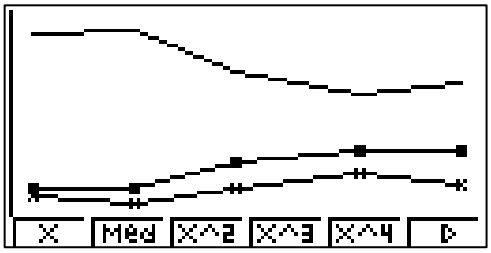
2. Is there any variation in the population make up of males, females, and young in the turkey populations among the years graphed?

Extension:

Use the percentages and the sample size to determine and graph the number of males, females, and young for the populations of turkeys.

Teacher Notes – Turkey Families:

1. The graph for the Turkey Populations is below.




2. Pressing the TRACE key and using the arrow keys will indicate that adult males always outnumber the adult females but are close to being equal percentages in the population. The greatest variation is in the young: some years there are more young than adults; some years the percentages of young and adults are about equal; and some years the adults outnumber the young.

3. Activity can also be completed using a standard spreadsheet application.

# *Who Just Swam By?*

Overview:
Students will analyze the data collected from observations of fish that swim past the viewing window at the Bosher's Dam Fishway.

SOL Connections:
Math 7.18, 8.14, A.7, A.8
Science 6.1, 6.7, LS.1, LS.11, LS.12

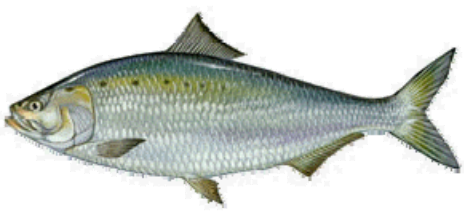
Background:
Two hundred years ago the need for hydropower resulted in the construction of dams on the James River. The water running over the dams produced the power needed to run the mills that supported the Richmond economy. The dams also blocked anadromous, or migratory, fish from reaching their historic spawning or breeding grounds upriver. Anadromous fish hatch in freshwater, and then swim out to the ocean where they grow and mature. When it is time to spawn, or reproduce, they return to the rivers and streams where they hatched years before.

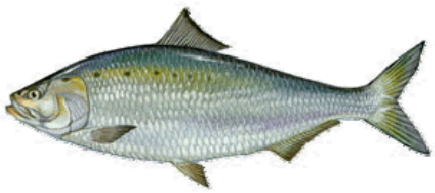
Because the construction of dams reduced the number of uninterrupted linear miles between the ocean and the freshwater spawning grounds, the populations of *American Shad* and other species of migratory fish eventually decline d. In an effort to recover these species the dams had to be altered. Since most were no longer in use, they were either removed or had small notches cut into them that the fish could swim through. The largest dam in Richmond and the last to be altered on the James River was Bosher's Dam. Because this dam was still in use, it could not be completely removed. Instead, a fishway was placed in the dam. A fishway is a ladder-like system that directs water flow from one side of the dam to the other. To check on the effectiveness of the fish way, an observation window was constructed in order for biologists to watch the fish swim by.

During the migratory season, a video camera records all fish that swim past the viewing window. You can view the fish by visiting http://www.dgif.virginia.gov/shadcam/ The "Shad Cam" is live only during those spring months when fish are migrating. Photos of the fishway and additional information about the shad and other migratory species are also available on this site.

American Shad is the target species for recovery since it is a valuable species in the Chesapeake Bay ecosystem. Other species of anadromous fish also use the fish way on their migration routes. In addition, freshwater species also use the fishway on their daily travels, including sunfish, large mouth bass and carp. Occasionally, a river otter will swim through in search of a dinner.

Problem:
Do any trends exist in numbers of fish swimming up the James River in a four year period?
In which species do you see a trend in the numbers?





Data Table:

Bosher Observation Window Data

| Fish Species | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|
| American Shad | 185 | 375 | 697 | 1066 |
| Sunfish | 1498 | 646 | 987 | 1184 |
| Hogsucker | 152 | 20 | 4 | 0 |

Keystrokes

1. Refer to Appendix 1, Calculator Set Up, to prepare the calculator. Be sure the Stat Wind in set for Auto.
2. Highlight STAT and press EXE.
3. Enter year data in List 1.
4. Enter shad data in List 2.
5. Enter sunfish data in List 3.
6. Enter hogsucker data in List 4. The screen should look like figure 1.

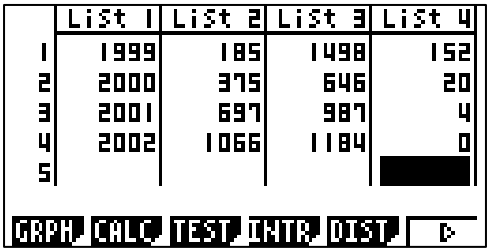



*Figure 1*

7. Press F1 and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 1, highlight Graph Type and press F2. Now highlight Xlist and press F1. Highlight Ylist and press F2. The screen will look like *figure 2* at the right. Press EXE. Press F6 to draw the graph.

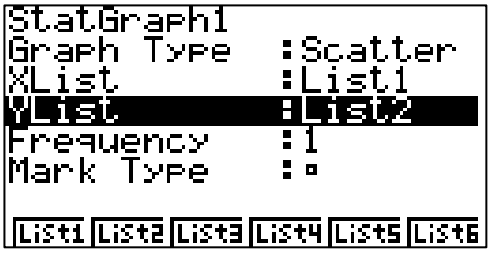



*Figure 2*

8. Press SHIFT and F1 to use the TRACE function and the arrow keys to sketch your plot below. Remember a graph needs a title and labeled axes.

9. Press EXIT and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 2, press F2, highlight Graph Type and press F2. Highlight Xlist and press F1. Now highlight Ylist and press F3. Finally, highlight Mark Type and press F2. The screen will look like *figure 3* at the right. Press EXE.

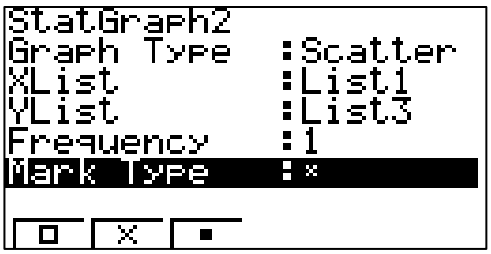



*Figure 3*

10. Press EXIT and F6 to get to the graph set up menu. To set up a line graph for Stat Graph 3, press F3, highlight Graph Type and press F2. Highlight Xlist and press F1. Now highlight Ylist and press F4. Finally, highlight Mark Type and press F3. The screen will look like *figure 4* at the right. Press EXE.

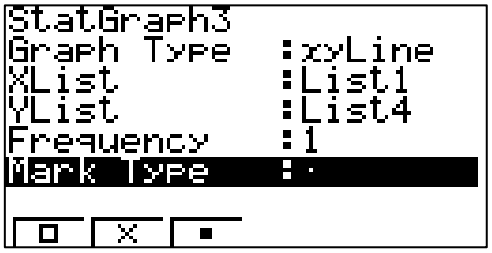



*Figure 4*

11. Press F4 and turn all of the graphs on by highlighting the graph and pressing F1. The screen should look like *figure 5*. Press EXE to see the graph.

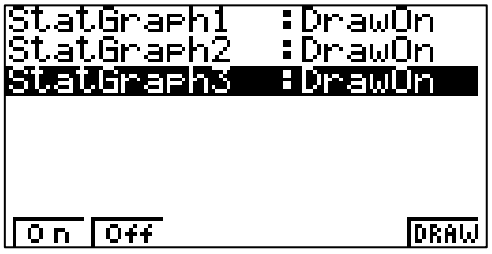



*Figure 5*

Analysis question:

1. Based on the definition of anadromous fish, which species is most likely to be anadromous and why?

Extension: Graph species from the table below and determine if any trends exist.

MORE BOSHER OBSERVATION WINDOW DATA

| FISH SPECIES | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|
| Longnose gar | 70 | 93 | 241 | 127 |
| Channel catfish | 671 | 835 | 1,100 | 201 |
| Quillback | 3,974 | 6,333 | 4,848 | 4,848 |
| Flathead catfish | 0 | 23 | 73 | 11 |

# Teacher Notes – Who Just Swam By?

1. The scatter plot shows a trend of increase for the American Shad, indicating that the population may be increasing. The Department's efforts are successful as the American Shad is recovering. See *Figure 1*.

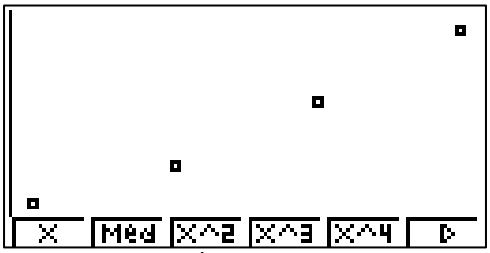



*Figure 1*

Students can check for the linear regression line by pressing F1, F5, EXE, and then F6. See *Figure 2*.

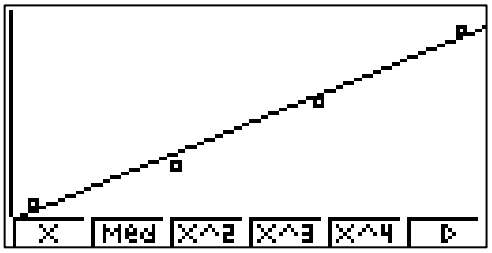
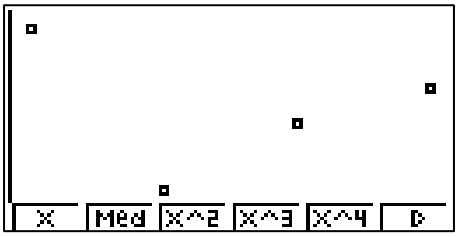
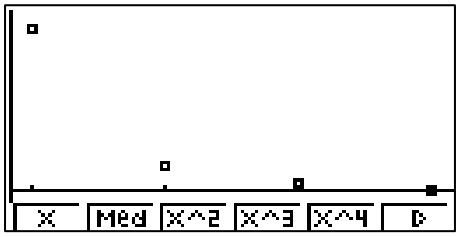



*Figure 2*

2. The scatter plots for the Sunfish and Hogsucker do not show any trends.

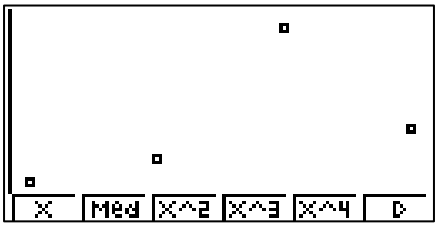



Sunfish

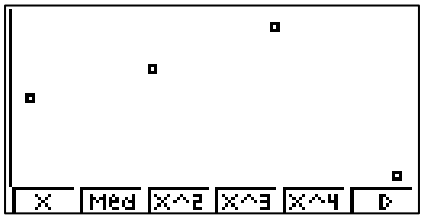



Hogsucker

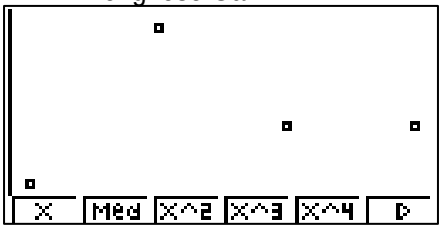
3. The fish on the extension also do not show any trends.



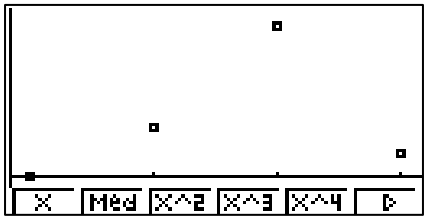

Longnose Gar




Channel Catfish




Quillback




Flathead Catfish

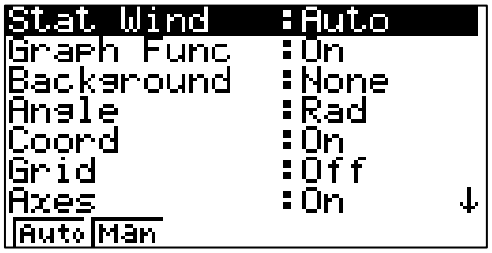
# APPENDIX 1

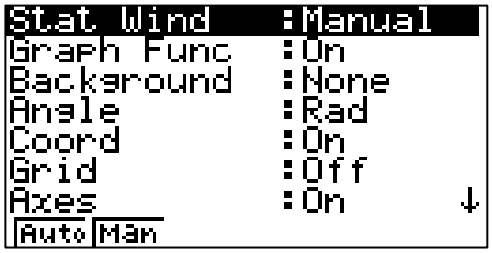
## Calculator Set Up

Before using the calculator to record and analyze data and create a graph of that data, it is recommended these steps be followed:

1. Turn on the calculator, highlight STAT on the Main Menu, and press EXE.

2. Press F6 to get to the Edit Screen. Highlight any list with data and press F4 and F1. Press F6 to get back to the main statistics screen. Press SHIFT and the Menu key to get to the set up screen for statistics. The screen will look like the one below on the left. To set up your own values for graphs, change Stat Wind (Statistics Window) to manual by pressing F2. The screen will look like the one on the right. Press EXE to accept the change and go back to the main statistics screen.




3. Press the Menu key to get to the Main Screen. Highlight TABLE and press EXE. Highlight each equation and press F2 and F1. This will clear the equations in both the TABLE and the GRAPH Menus. Press the Menu key to get back to the Main Menu

# Glossary

Terms used in the field of wildlife management

*Anadromous*: species of fish that live their lives in the ocean and return to the freshwater rivers where they hatched to spawn. In Virginia, the striped bass, shad, sturgeon and herring are all anadromous fish.

*Carrying Capacity:* the maximum number of individuals that a given environment can support without detrimental effects to the ecosystem.

*Ecosystem:* a natural unit that includes living and nonliving parts interacting to produce a stable system in which the exchange of materials between the living and nonliving parts follows closed paths.

*Fledgling:* a young bird who has the feathers necessary to begin to fly or to leave the nest.

*Hatchery:* where fish are hatched or raised until released, also called a fish cultural station.

*Hibernation:* the act of passing the winter, or a portion of it, in a state of sleep; a torpid or resting state.

Limiting factors: influences in the life history of any animal, population of animals, or species (e.g. food, water, shelters, space, disease, predation, climate conditions, etc)

Mast: The fruits or nuts of wild plants and trees.

*Riparian buffer:* the area of land along a stream, river, lake or other body of water. The plants along this edge hold soil and filter runoff before it reaches the waterway.

*Waterfowl:* water birds, usually refers to ducks, geese and swans.

Some definitions are from the Project WILD activity guide glossary.
Additional information about Project WILD in Virginia is below.

Thank you for using this guide with your students. In addition to building math skills, the activities will increase understanding of Virginia's wildlife resource and how local scientists use math to answer biological questions.

For more information about Virginia's wildlife resources visit us on the web at www.dgif.virginia.gov . The Department provides a ***Virginia Wildlife*** magazine subscription to all public schools in the Commonwealth. The magazine will provide your class with additional information on wildlife research projects as results are published.

The Virginia Department of Game and Inland Fisheries is the state sponsor of **Project WILD**, a K-12 wildlife education program available through free workshops. If you are interested in attending a Project WILD workshop contact:

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